AECon 2020
Proceedings of The 6th Asia-Pacific Education And Science Conference
Purwokerto, Indonesia
19-20 December 2020

EDITORS
Saefurrohman
Malim Muhammad
Heri Nurdiyanto
Proceedings of The 6th Asia-Pacific Education And Science Conference
19-20 December 2020, Purwokerto, Indonesia

AECon 2020

General Chairs
Malim Muhammad, Faculty of Teacher Training and Education, Universitas Muhammadiyah
Purwokerto, Indonesia

Technical Programme Chair
Listika Yusi Risnani, Faculty of Teacher Training and Education, Universitas Muhammadiyah
Purwokerto, Indonesia

Lia Mareza, Faculty of Teacher Training and Education, Universitas Muhammadiyah Purwokerto,
Indonesia
Conference Organization

Steering Committee

William (Bill) Atweh   Curtin University
Mohammad Zain Musa  Royal Academy of Cambodia
Muchlas Samani   Universitas Negeri Surabaya
Darhim    Universitas Pendidikan Indonesia
Zulkifley Mohammed  Universiti Pendidikan Sultan Idris
Melor MD Yunus   Universiti Kebangsaan Malaysia
Alexius Chia    National Institute of Education
Akhsanul In’am   Universitas Muhammadiyah Malang

Organizing Committee

General Chair
Malim Muhammad  Universitas Muhammadiyah Purwokerto

General Co-Chairs
Listika Yusi Risnani  Universitas Muhammadiyah Purwokerto
Lia Mareza   Universitas Muhammadiyah Purwokerto

TPC Chair and Co-Chair
Asep Bayu Nandiyanto Universitas Pendidikan Indonesia

Sponsorship and Exhibit Chair
Arum Adita   Universitas Muhammadiyah Purwokerto

Local Chair
Saefurrohman  Universitas Muhammadiyah Purwokerto

Workshops Chair
Arifin Suryo Nugroho Universitas Muhammadiyah Purwokerto

Publicity & Social Media Chair
Sakinah Fathrunnadi Universitas Muhammadiyah Purwokerto

Publications Chair
Melati Ismi Hapsari   Universitas Muhammadiyah Purwokerto

Web Chair
Lukni Maulana   Universitas Muhammadiyah Purwokerto

Posters and PhD Track Chair
Arifin Muslim Universitas Muhammadiyah Purwokerto

Panels Chair
Eko Suroso   Universitas Muhammadiyah Purwokerto

Demos Chair
Cicih Wiarsih  Universitas Muhammadiyah Purwokerto

Tutorials Chairs
Susanto   Universitas Muhammadiyah Purwokerto
**Technical Program Committee**

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lena Danaia</td>
<td>Charles Sturt University</td>
</tr>
<tr>
<td>Corrienna Abdul Talib</td>
<td>University Teknologi Malaysia</td>
</tr>
<tr>
<td>Ari Widodo</td>
<td>Universitas Pendidikan Indonesia</td>
</tr>
<tr>
<td>Sisunandar</td>
<td>Universitas Muhammadiyah Purwokerto</td>
</tr>
<tr>
<td>Tanto Sukardi</td>
<td>Universitas Muhammadiyah Purwokerto</td>
</tr>
</tbody>
</table>
## Contents

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synthesized Zeolite from Coal Fly Ash: Effect of Furnace and Acidic Pretreatment on the Characteristic</td>
<td>1</td>
</tr>
<tr>
<td><em>Aini Nadhokhotani Herpi, Rika Tri Yunarti, Asep Saefumillah</em></td>
<td></td>
</tr>
<tr>
<td>Political Discourse Analysis of Jokowi vs Prabowo Subiyanto Speeches in the First Presidential Election Debate: Critical Thinking Perspectives</td>
<td>8</td>
</tr>
<tr>
<td><em>Sudar Sudar</em></td>
<td></td>
</tr>
<tr>
<td>Development of Friction Force Quiz (F2Q) to Support Learning Evaluation on Friction Force Material in Class X SHS</td>
<td>14</td>
</tr>
<tr>
<td><em>Edi Supriana, Salsabila Indana Zulfa, Monica Widyaswari, Ulya Aziza Fitriya</em></td>
<td></td>
</tr>
<tr>
<td>The Relations Teacher Profession Interest and Teacher Attitudes with Readiness Teaching Students Study Program Office Administration of Education Faculty of Economics Yogyakarta State University</td>
<td>28</td>
</tr>
<tr>
<td><em>Fitri Handayani Setiyadi, Cepi Safruddin Abdul Jabar, Siti Umi Khayatun Mardiyah</em></td>
<td></td>
</tr>
<tr>
<td>Use of the Quizizz Application in Providing Evaluation of Science Learning in Grade 6 Elementary School Students</td>
<td>36</td>
</tr>
<tr>
<td><em>Fitria D. Anggraeni, Sukarno Sukarno, Muzzazinah Muzzazinah</em></td>
<td></td>
</tr>
<tr>
<td>Biocompatibility Test of Ceramic Materials in Zebrafish Development</td>
<td>48</td>
</tr>
<tr>
<td><em>Husnul Budiatman Dani, Ika Dewi Ana, Bambang Retnoaji</em></td>
<td></td>
</tr>
<tr>
<td><em>I Komang Wisnu Budi Wijaya, Ni Putu Juni Artini, Ni Kadex Ayu Kristianyanti, L. Virginayoga Hignasari, I Putu Oktap Indrawan, I Gusti Ayu Agung Sinta Diarini</em></td>
<td></td>
</tr>
<tr>
<td>Digital Marketing Chatbot Using API Dialog Flow Case Studi ITB Stikom Bali, Jimbaran Campus</td>
<td>71</td>
</tr>
<tr>
<td><em>I Putu Gede Abdi Sudiatmika, Made Suci Ariantini</em></td>
<td></td>
</tr>
<tr>
<td>The Effectiveness of Authentic Project-Based Assessment on the Online Learning System Toward Learning Result of Student Viewed from Critical Thinking Ability</td>
<td>80</td>
</tr>
<tr>
<td><em>Komang Hari Santhi Dewi, I Nyoman Bagus Pramartha</em></td>
<td></td>
</tr>
<tr>
<td>Students’ Perception toward Unwillingness to Participate in EFL Classroom</td>
<td>88</td>
</tr>
<tr>
<td><em>Meicy Intan Sari, Anisha Ayu Anindy, Mochammad M Romadon, Bambang Widi Pratolo</em></td>
<td></td>
</tr>
<tr>
<td>The Strategy of Character Education Instilment in SDIT Az-Zahra Sragen</td>
<td>100</td>
</tr>
<tr>
<td><em>Munif Rofi’atur Rohmah, Husaini Usman</em></td>
<td></td>
</tr>
<tr>
<td>Analogy Supported-Scientific Explanation Text to Improve High School Students’ Understanding of The Concept of Heat Transfer</td>
<td>106</td>
</tr>
<tr>
<td><em>D Nurdiansah, A Suhandi, R Efendi</em></td>
<td></td>
</tr>
<tr>
<td>Analysis of Students’ Mathematical Communication Ability Based on Mathematical Resilience during the Covid-19 Pandemic</td>
<td>115</td>
</tr>
<tr>
<td><em>Afroh Mahfudoh Al'atif, Nanang Priatna, Yaya Sukjaya Kusumah, Suhendra Suhendra</em></td>
<td></td>
</tr>
</tbody>
</table>
Extract of Bitter Melon (Momordica Charantia L.) as a Cytotoxic and Anti-Proliferation Agent for Cells WiDr (Colon Cancer)
Eka Yulianti, Sutiarso Sutiarso, Hendri Busman, Nunung Nurcahyani, Sri Wahyuningsih

Estimation of The Effect Size Meta Measurement Model with Generalized Method of Moments Approach
Hary Suprihanto, Bambang Widjanarko Otok, Agus Suharsono

Imbalanced Data Analysis of Adolescent Risk Behavior of Drug Abuse using Random Forest
Ismaini Zain, Kartika Fithiasari, Erma Oktania Permatasari, Tyas Ajeng Nastiti, Mardyono Mardyono, Nilam Novita Sari, Resti Pujiasvuty, Sri Lilestina Nasution

Pseudo Thinking of the Social Arithmetic: A Case Study
Lathifah Rahmi, Sufyani Prabawanto

Students' Difficulties in Solving Ratios and Proportional Relationships
Nabila Ismi Fauziah, Endang Cahya M.A

The Impact of Learning in Nature for The Well-being of Children with Special Needs
Melati Ismi Hapsari, Lia Mareza

Bioavailability of Nickel (Ni) in Spiked Soils by Sequential Extraction and Its Bioaccumulation in Basil (Ocimum Africanum L)
Nopja A.R, Asep Saefumillah, Askal Maimulyanti

Internet of Things for Smart Future Science Laboratory in Middle School: A Literature Review
N F Kusuma, J Ikhsan, A Hujatulatif, K Huda

Analysis of the Problem Solving Ability of Mathematics Education Students Using the Trigonometry Module
Rahmatya Nurmeidina, Ahmad Lazwardi, Arif Ganda Nugroho

Bioavailability of Chromium in Spiked Soil by Sequential Extraction and Its Absorption in Amaranthus hybridus
Siti Karimah, Asep Saefumillah, Askal Maimulyanti

The Muntingia calabura Leaves Extract Effect on Respiration and Heart Performance of Zebrafish (Danio rerio): The Search for Covid-19 Control Agent
Siti Zar‘ah, Bambang Retnoa Ji

Modelling The Number of Unemployment in East Java: Negative Binomial Regression Approach
Zakiatul Wildani, Sri Pingit Wulandari

Virtual Laboratory Based on Discovery Learning to Train an Analyzing-Interpreting Data: A Systematic Review
Trijayanti P, Nurfina Aznam, Krisma Haryuniati

The Analysis of Senior High School Students’ Mathematical Communication Skill of Trigonometric Material
Upi Lidinillah, Endang Cahya M.A.
The Implemented of Somatic, Auditory, Visualization, Intellectually, Repetition (SAVIR) Strategy toward Improved of Subject Learning Based on Multicultural Social Studies Learning
Ine Kusuma Aryani, Subuh Anggoro

Directions and Trends of Mathematical Education Research in Indonesia
RH Simanungkalit, Kartono Kartono, SB Waluya, Rochmad Rochmad, Isnarto Isnarto

Students’ Mathematics Representation of the Statistics: A Case Study
Alfian Eka Utama, Sufyani Prabawanto

The Role Women in Improving Islamic Perspektif of The Current Context
Ana Andriani, Wakhudin Wakhudin

Visual Pawukon on Decorative Lighting
Anung B Studyanto, Setyawan Setyawan, Rahaman Widayat

Development of Powerpoint-Based Multimedia for Elementary School Teachers
Azizah Hayati, Ristiana Dyah Purwandari

The Effects of Instructional Leadership and Organizational Culture on Teacher Performance at Public Senior High Schools in Sleman Regency, Indonesia
Banu Widiasmara, Dwi Esti Andriani

Deconstructing Physics Problems Using Testlet Templates
Budi Naini Mindyarto, Sugiyanto Sugiyanto

Analysis of School Climate Factors as Predictors of Academic Achievement in Junior High Schools: A Literature Review
Marani Cahya Ningtias, Suyanto Suyanto, Amika Wardana, Deri Indrahadi

Analysis of Student's Critical Thinking Ability Based on Gender
Muthiah Fildzah Noverli, Endang Cahya

Improving Constructing Explanations and Designing Solutions Skills based on NGSS through Project-Based Learning: A Systematic Review
Novia Rhike Dyah Pitaloka, Suyanta Suyanta, Khoirul Huda

An Analysis of the Conformity Level between the Importance Level and Program Performance at the Subject Teacher Forum
Prawidi Wisnu Subroto, Sigit Raharjo

Green Synthesis of Porous Fe2O3/Au Nanocomposite with Chitosan Template using Gliricidia Sepium Leaf Aqueous Extract and its Catalytic Activity for the Reduction of 4 Nitrophenols
Purnomo Arif Abdillah, Yoki Yulizar

Digital Literacy of Students Using R Language
Rahma Wahyu, Sinollah Sinollah

Text Mining to Analyse Publication Topics of COVID-19 using HDP and LDA Methods
Rakhmah Wahyu Mayasari, Kartika Fithiasari, Dedy Dwi Prastyo
Synthesis and Characterization of Samarium or Lanthanum-Based Metal-Organic Frameworks with Crysophenine Ligand
*Riska Yulianiza, Agustino Zulya, Jarnuzi Gunlazuardi*

The Development of Android Educational Game “MENALAR” for Ten Grade High School Students
*Ryan Angga Pratama, Rahayu Sri Waskitingntyas*

Two-Dimensional Bayesian Information Criteria for Spatial Poisson Point Process (Case Study: Spatial Distribution Modeling of a Tree Species in Barro Colorado Island)
*Sigit Dwi Prabowo, Achmad Choiruddin, Nur Iriawan*

The Effect of Flashcards on Students in Writing Vocabulary at Seventh Grade of MTs Al Ulum
*Nurhalimah Nurhalimah, Sumarsih Sumarsih, Rahmad Husein*

BR+ for Addressing Imbalanced Multilabel Data Classification Combined with Resampling Technique
*Nilam Novita Sari, Ismaini Zain, Kartika Fithriasari, Amri Muhaimin*

Internet of Things (IoT) on Fostering Meaningful Science Learning: A Literature Review
*A Hujatulatif, J Ikhsan, I N Khoiriza*

Analysis of Learning Difficulties Learning Cultural Arts as a Form of Creativity for Elementary School
*Lia Mareza*

The Application of Padlet in Teaching and Learning of Writing Recount Text at Senior High School in Palu City
*Ernitasari Mulyadi, Andi Naniwarsih, F A Omolu, I Manangkari, D Rara Amiati*

Covid-19 Effect on Economic Growth and Employment in Eastern Indonesia Area
*MA Djirimu, Andi Darmawati Tombolotutu, Failur Rahman, Sri Haryani*

Implementation of Muhammadiyah Cultural Da’wah In the Education Sector in Palu City
*Surni Kadir, Nuranisa Nuranisa, Gazali Gazali, A Asikin, Ernitasari Mulyadi*

Homeschooling, Obstacles, and Solutions In Palu Central Sulawesi
*Abdul Halik, Fatmah Fatmah, Rahmawati Rahmawati*

Student Errors in Completing Mathematical Story Problems Based on Watson’s Criteria During Pandemic COVID-19
*Malim Muhammad*

Improving Academic Success Through Applied Learning Theories, A General Elective (GE) Course
*O A P Tulabut, R S Mangalus, R N C Cruz, A B Gonzales, E L L Pare, I M C Evaristo, C L M De Ala*

Faith and Wisdom Based Education
*Susanto Susanto*

Age, Gender, Level, and Grade Effect on Foreign Language Learning Strategy
*Saefurrohman Saefurrohman*
Implicature of Identity Reinforcement in The Speak of Emha Ainun Nadjib (Cak Nun) on Video Youtube
Eko Suroso, Sumarlam Sumarlam, M. Rohmadi, Sumarwati Sumarwati

The Role of Class Teachers in The Implementation of Guidance and Counseling in The Formation of Characters in Children with Special Needs
Lia Mareza

Media Literacy Profiles of Biology Pre-Service Teacher Candidates in the 21st Century in the Biology Education Departement, Universitas Muhammadiyah Purwokerto
Listika Yusi Risnani

Development of Inferential Statistics Teaching Materials Using ADDIE Model
Malim Muhammad, Lukmanul Akhsani

PAKARNA (Papan Angka Berwarna) in Arithmetic Series Material
Rahayu Kariadinata, Juariah Juariah, Anis Niswatul Maula

Lanthanides MOFs (Samarium, Europium, and Terbium) Characteristics and Its Possible Potentials
Fahdnul Ashim, Agustino Zulys Zulys, Jarnuzi Gunlazuardi

Bacteriological Test of Food Equipment in Basic School Canteen Working Area UPTD Puskesmas Mabelopura
Finta amalinda, Novi susanti, Miswan Miswan, Nur afni, Arief muliawan, Agus halid

Development of a Green City Concept Through Waste Management to Increase Community Income
Rukhayati Rukhayati, Sri Haryani, Pariyati Pariyati

Analysis Interaction Patterns of People In Dongi-Dongi Towards The Management Of Forest Resources
Sitti Aminah, A Muis, Livawanti Livawanti, Rafiuddin Rafiuddin, R Gailea

Characterization of the Test of Scientific Reasoning Ability of Static Fluid Material for Prospective Physics Teachers: the Polytomous Rasch Analysis Authors'
Unang Purwana, Dadi Rusdiana, Winny Liliawati

Implementation of Problem-Project Based Learning Model in Elementary School
Ilham Aji Asmara Dewa, Ristiana Dyah Purwandari

External Quality Assurance Model in HEIs: 3-D ACS Framework
Maria Magdalena Wahyuni Inderawati, PoTsang B Huang, Ronald Sukwadi

Knowledge Level of Medicinal Plant Utilization and Conservation Efforts of Communities around Nature Conservation Areas in Central Sulawesi
Rosmaniar Gailea, R Nurdin, M. S. Nasrun, Siiti Aminah, A. T. Paramitha

Straight Motion: A Mobile Application for Learning Linear Motion
Elisabeth Pratidhina, Ferina Rizky Yuliani, Johannes V D Wirjawan, Herwinarso Herwinarso, Budijanto Untung

Emergency School Learning Model with Disaster Management in Post-Earthquake Areas in Palu City
Normawati Normawati, Muhammad Rizal Masul, Mansur Mansur, Nuranisa Nuranisa
Perceptions and Anxiety Level of Eight Grade Students Engaged in Guided Inquiry Physics Experiment
L D Oraa, V M Mistades

Module and Learning Resources of Students for Developing a Local Wisdom-Based Biotechnology Module: a Preliminary Research
Desti Desti, Fitmawati Fitmawati, Putri Ade Rahma Yulis, Mayta Novaliza Isda
Synthesized Zeolite from Coal Fly Ash: Effect of Furnace and Acidic Pretreatment on the Characteristic

Aini Nadhokhotani Herpi¹, Rika Tri Yunarti², Asep Saefumillah³
{aininadhokhotani@ui.ac.id¹, rika.tri@sci.ui.ac.id², asep.saefumillah@sci.ui.ac.id³}

Department of Chemistry, Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Indonesia. Kampus UI Depok, Depok 16424, Indonesia

Abstract. Waste management is a widespread problem all across the world. Fly ash is one of the wastes generated in a large amount, where disposal of fly ash by landfill takes up agricultural lands and also causes serious problems in the respiratory system. Meanwhile, fly ash contains high silica-alumina, so that it can be used as a raw material to synthesize zeolite. In this work, fly ash from industrial synthesized into zeolite type NaP1, and the effectiveness of furnace and acidic pretreatment was studied. The synthesis of class F fly ash from Indonesia was subjected to a 36-hour hydrothermal reaction with sodium hydroxide. Synthesized zeolite was characterized by X-ray diffractometry to obtain the crystal structure of the zeolite, X-ray fluorescence to obtain the mineral composition, and SEM to obtain morphological study. XRF data shows that pretreatment of fly ash has no significant effect on the content of fly ash itself, however, when fly ash was converted into zeolites, the resulting zeolites had a higher crystallinity compared to fly ash without pretreatment. It was found that the most effective pretreatment was when zeolite formed from fly ash with acidic pretreatment using 20 wt% HCl at 80 °C for 2 hours.

Keywords: coal, coal fly ash, fly ash pretreatment, zeolite, hydrothermal

1. Introduction

Fly ash is a waste of coal combustion which formed from a mineral substance based on silica-alumina [1]. Coal production worldwide is estimated at 780 million tonnes per year [2][3]. Moreover, Indonesia has a large amount of power plant producing fly ash as its by-product. Fly ash contains amorphous alumina-silicate material, mainly quartz (SiO₂), mullite (3Al₂O₃.2SiO₂), hematite (Fe₂O₃), magnetite (Fe₃O₄), and more elements and their oxides in a trace amount to several percentages [4][5]. Among all fly ash produced, the utilization of fly ash is only about 25%, and the rest is disposed of as waste that causes environmental issues [6]. If untreated, fly ash waste must be isolated to avoid the movement of pollutants such as heavy metals into agricultural or aquatic environments [7]. Therefore, the utilization of fly ash gets more attention and becomes the most common waste studied [8].

Many studies have been conducted using fly ash as raw material, including using fly ash as a raw material for zeolite synthesis [9][10], construction / industrial work [11], removal of toxic metals [12], removing inorganic compounds [13], removing dyes [14], etc. In this work, fly ash was synthesized into zeolite, and the effect of pretreatment on the resulting zeolite was studied. Zeolitization of fly ash could be an ideal yet inexpensive method to utilize fly ash and reduce its impact on the environment [3]. Zeolites are microporous, hydrated aluminosilicates
structured into three-dimensional networks of tetrahedra $\text{TO}_4$ ($\text{T} = \text{Si}, \text{Al}$) joined at the corners by oxygen atoms [4], which, in its crystal structure, contain numerous channels and chambers of different size that provides various sorption ion exchange and catalyst properties [6]. Previous researchers have conducted several studies to synthesize zeolite from fly ash by hydrothermal conversion with alkali solution study various parameters that alter configuration and properties of zeolite [3][6][15]. This paper focuses on how pretreatment affects the properties of zeolite. Zeolite synthesized from fly ash allows waste converted into high-value products of cations, which have wide applications used as adsorbents, molecular sieves, wastewater treatment, and many more [15][6]. There are additional measures here in this work that boost the characteristics and quality of the zeolite compared to zeolite without any pretreatment. A previous study shows that thermal stability and the behavior of the resulting zeolite are improved by acidic pretreatment [5] while another study shows that furnace pretreatment increases the adsorption capacity of synthesized zeolite [3]. This study compared the effect of those two pretreatments by analyzing the characteristic of raw fly ash, zeolite synthesized with fusion pretreatment, and zeolite synthesized with acidic pretreatment.

2. Method

2.1 Fly ash and reagents

The raw fly ash used in the experiment was obtained from PT Sinar Mas Argo Resources and Technology (SMART Tbk), Indonesia. SMART Tbk is a leading agribusiness company that focused on sustainable palm oil production. According to the American Society for Testing and Materials (ASTM) C618, the fly ash used in this experiment is F type because the sum of the major compound ($\text{SiO}_2$, $\text{Al}_2\text{O}_3$, and $\text{Fe}_2\text{O}_3$) is over 70% and $\text{SO}_3$ less than 5%. The reagent used in this research is sodium hydroxide (Merck, ≥99%), hydrochloric acid 37% with analytical purity.

2.2 Material characterization

The chemical compositions of fly ash and zeolite samples were determined using Panalytical Epsilon1 X-ray fluorescence spectroscopy (XRF). The X-ray diffractions (XRD) analysis was conducted using Panalytical X’Pert Pro MPD. The 2$\theta$ range was from 5° to 40° with Cu Kα radiation. The morphology analyses were performed using FEI Quanta 650 Scanning Electron Microscopy (SEM).

2.3 Preparation of zeolite

The amorphous $\text{SiO}_2$ and $\text{Al}_2\text{O}_3$ in fly ash are used as silica and aluminum source for the synthesis of zeolite. Fly ash was screened through a sieve shaker of 80 mesh size to remove coarse particles and dried at 150 °C for 4 hours. For each type of zeolite, the following process pretreatment were applied: 1) calcination process of fly ash at 850 °C for 2 hours, 2) treatment with hydrochloric acid (20 wt% HCl) at 80 °C for 2 hr (solid/liquid ratio of 1:10). Both fly ash with different pretreatment underwent a hydrothermal reaction: 10 gr of fly ash, 6 gr of $\text{NaOH}$, and 45 ml of double-distilled water at 80 °C for 36 hours.
3. Results and Discussion

3.1 Zeolite Synthesis Condition

Three types of fly ash are used to determine the effect of pretreatment on the resulting zeolite namely fly ash without pretreatment (FA), fly ash with furnace pretreatment (FA-1), and fly ash with acidic pretreatment, so that there are three types of zeolite produced, namely zeolite from fly ash without pretreatment (ZE), zeolite from fly ash with furnace pretreatment (ZE-1) and zeolite from fly ash with acidic pretreatment (ZE-2). Both fly ash samples were screened through an 80 mesh size sieve shaker and heated for 4 hours at 150 °C to extract the moisture in the sample. All fly ash samples were screened through a sieve shaker of 80 mesh size and heated at 150 °C for 4 hours to remove moisture contained in the sample. RFA sample obtained by directly synthesizing the fly ash by a hydrothermal method in an autoclave at 80 °C for 36 hours, resulting ZE sample. FA-1 sample was obtained by providing furnace pretreatment at a temperature of 650 °C for 2 hours, resulting in a light brown fly ash. The FA-1 sample was then synthesized by the same hydrothermal method resulting in ZE-1 sample. The FA-1 sample was then synthesized by the same hydrothermal method resulting in ZE-1 sample. Meanwhile, FA-2 sample was pre-treated by reacting fly ash with 20% hydrochloric acid with a solid : liquid ratio of 1:10 at 80 °C for 2 hours produces fly ash with a grey color that is lighter than RFA. FA-2 was washed to a neutral pH and then synthesized by the same hydrothermal method resulting in ZE-2 sample. In order to assess the effect of fly ash quality on the zeolite made, the use of various starting materials was investigated. The hydrothermal process includes the dissolution of fly ash in an alkaline solution and the synthesis by thermal treatment of zeolite materials [17]. Formation of zeolite performed according to the following chemical reaction:

$$\text{Fly ash} + 3.3 \text{ mol dm}^{-3} \text{NaOH} \rightarrow \text{36 hr, 80°C} \rightarrow \text{zeolite + residuum}$$

3.2 Characterization of Synthesized Zeolite

Table 1 shows the chemical composition and molar Si/Al ratio of all materials used in this work. The main components of the three types of fly ashes were the oxide form of Si, Al, Fe accounting for around 83% and there were no significant variations in compositions between them. Meanwhile, there were significant differences between synthesized materials where ZE-2 has the highest main component percentage. As a result of this composition, ZE-2 is classified as a material with high silica and alumina content and low-level impurities [18]. The molar Si/Al ratio of RFA, FA-1, FA-2, ZE, and ZE-1 was similar around 2.69 to 2.77. As shown in Table 1, acidic pretreatment decreases the unwanted portion by a substantial amount. This influenced the percentage of Si and Al, which are the key components of the zeolite formation. An increase in wt% of Si and a decrease in wt% of Al led to an increase in molar Si/Al ratio to 4.83 which could cause the resulting zeolite tends to have a high level of crystallinity.

Based on the key d-spacing dhkl = 6.21, 5.59, 4.53, 3.89, 3.76, 3.39, 3.12, 2.97, and 2.54 Å, the presence of the ZE zeolitic phase in the reaction products was determined. On the basis of the key d-spacing dhkl = 6.17, 5.59, 4.53, 3.90, 3.77, 3.41, 3.11, 2.99 and 2.54 Å, the presence of the ZE-1 zeolitic phase in the reaction products was calculated. Based on the key d-spacing dhkl = 6.17, 4.53, 3.90, 3.76, 3.12, 2.98, and 2.544 Å the presence of the ZE-2 zeolitic phase in the reaction products was determined. There were no significant differences between XRD diffractogram of RFA, FA-1, and FA-2, each of them was composed of an amorphous phase with a low quantity of crystalline (quartz and NaP1). The highest XRD intensities appear on zeolite with acidic pretreatment suggested that acidic pretreatment is required to generate higher crystallized zeolite. In the XRD patterns, the weak peaks of ZE-1 indicate the conversion from
the amorphous phase to the zeolite phase occurred. Formation of zeolite from fly ash without any pretreatment results in a zeolite with lower XRD intensities.

Table 1. Chemical composition and molar ratio Si/Al of fly ash and synthesized zeolite

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RFA</th>
<th>FA-1</th>
<th>FA-2</th>
<th>ZE-1</th>
<th>ZE-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al₂O₃</td>
<td>18.87</td>
<td>19.07</td>
<td>19.10</td>
<td>17.71</td>
<td>14.12</td>
</tr>
<tr>
<td>SiO₂</td>
<td>52.21</td>
<td>51.93</td>
<td>52.01</td>
<td>47.68</td>
<td>39.02</td>
</tr>
<tr>
<td>P₂O₅</td>
<td>1.20</td>
<td>1.21</td>
<td>1.20</td>
<td>1.03</td>
<td>0.90</td>
</tr>
<tr>
<td>SO₃</td>
<td>1.38</td>
<td>1.45</td>
<td>1.46</td>
<td>1.15</td>
<td>0.70</td>
</tr>
<tr>
<td>Cl₂</td>
<td>0.42</td>
<td>0.38</td>
<td>0.41</td>
<td>0.49</td>
<td>0.90</td>
</tr>
<tr>
<td>K₂O</td>
<td>1.04</td>
<td>1.03</td>
<td>1.02</td>
<td>0.46</td>
<td>0.73</td>
</tr>
<tr>
<td>CaO</td>
<td>9.94</td>
<td>10.01</td>
<td>9.98</td>
<td>11.22</td>
<td>14.83</td>
</tr>
<tr>
<td>TiO₂</td>
<td>2.47</td>
<td>2.46</td>
<td>2.42</td>
<td>2.94</td>
<td>3.49</td>
</tr>
<tr>
<td>MnO</td>
<td>0.18</td>
<td>0.17</td>
<td>0.17</td>
<td>0.22</td>
<td>0.35</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>11.99</td>
<td>11.89</td>
<td>11.79</td>
<td>16.75</td>
<td>24.17</td>
</tr>
<tr>
<td>As₂O₃</td>
<td>0.01</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>SrO</td>
<td>0.01</td>
<td>0.27</td>
<td>0.28</td>
<td>0.24</td>
<td>0.50</td>
</tr>
<tr>
<td>Ag₂O</td>
<td>0.21</td>
<td>0.13</td>
<td>0.16</td>
<td>0.21</td>
<td>0.30</td>
</tr>
<tr>
<td>Total</td>
<td>99.93</td>
<td>100.00</td>
<td>100.00</td>
<td>100.10</td>
<td>100.01</td>
</tr>
<tr>
<td>Si/Al</td>
<td>2.77</td>
<td>2.72</td>
<td>2.72</td>
<td>2.69</td>
<td>2.76</td>
</tr>
<tr>
<td>SiO₂ + Al₂O₃ + Fe₂O₃</td>
<td>83.07</td>
<td>82.89</td>
<td>82.90</td>
<td>82.14</td>
<td>77.31</td>
</tr>
</tbody>
</table>

Figure 1. XRD patterns of fly ash and synthesized zeolite
The surface morphology of fly ash in Figure 2 suggested that amorphous aluminosilicate spheres were the dominant morphological types occurring in the studied fly ash, while Figure 3 displayed structures of zeolite NaP1 type as previously reported in the literature.

Figure 2. SEM image for raw fly ash

Figure 3. SEM image of zeolite with furnace pretreatment (left) and acidic pretreatment (right).
4. Conclusion

Pretreatment of fly ash affects the properties of the zeolites produced. Furnace pretreatment did not have a significant impact on both fly ash and the resulting zeolite. Zeolite without pretreatment and zeolite with furnace pretreatment had similar properties and Si/Al ratio although there was a slight difference in the morphology. Pretreatment using acid showed the best result on the resulting zeolite, proven by affecting the ratio Si/Al of the resulting zeolite reaching 4.83. The SEM image of the finest zeolite shows a sharp crystal structure and high intensity peaks are seen in the XRD image. By lowering the trace, harmful, and unwanted materials from the fly ash that is the key to high intensity in XRD, acidic pretreatment causes a big weight reduction. For further research, it is suggested to test the effectiveness of the material for application in waste water treatment.

Acknowledgments. The Authors would like to thank the Directorate of Research and Community Engagement, Universitas Indonesia, for funding the research and publication cost through HIBAH PUTI with Grant No.: NKB-4926/UN2.RST/HKP.05.00/2020.

Reference


Political Discourse Analysis of Jokowi vs Prabowo Subiyanto Speeches in the First Presidential Election Debate: Critical Thinking Perspectives

Sudar
{rofiqsdr@gmail.com}

Universitas Muhammadiyah Purworejo, KH.A.Dahlan Street No.3
Purworejo.54111.Tel/Faxs.0275321494, Central Java, Indonesia.

Abstract. This paper aims to discuss the issues of political news that happened in our country, and it is hot-news that was recently conducted by the Indonesian Government. It is the general election of the President. In the process of the Presidential Election, there is a crucial process, and it is the debate that is conducted five times, from the first and the last session. In this paper, the writer would like to discuss the speeches spoken by Jokowi and Prabowo. The first debate was conducted on January 18, 2019. It was the period that really waited for society, how Jokowi and Prabowo debated each other. It is necessary to know what kinds of speeches they used to argue both of them to talk about political life in Indonesia. It can be used as a material of reading skills from critical thinking perspectives.

Keywords: Political Discourse, Speeches, Critical Thinking, Presidential Candidate, Election.

1 Introduction

Understanding the speeches based on the context of situation and culture is necessary to be developed among the language learners. This skill is concerning to the language learners, how and why they should understand the speeches spoken by other speakers in different contexts. Further, the writer would like to discuss and share how to dig up the speeches spoken by certain people in a particular context from the political discourse analysis. It is identified specifically about the speech that commonly contains the speaker's intent and to understand the public's ideas. [1] Political speech commonly contains the speaker’s intent to catch the public’s attention. The contents of the speech, such as; the speaker's purposes, the importance of the speech, and it is usually accompanied by a photo, picture, statistic, related to the topic of speech. [2] Political Discourse Analysis (PDA) is a kind of knowledge that inter-and multidisciplinary. [3] political discourse (PD) is speeches that perform both formal and non-formal concerning politics. Furthermore, Banhegyi, Matyas mentioned there are three components of political contents, namely; text, power and ideology.
2 Literature Review

Text represents the actions of a person or group of people in both formal and non-formal speeches. Further, power is the human of maintaining and obtaining the contents of communication. Then, Ideology is the basic belief which is underlined in the representations of individuals or a social group. Furthermore, politics and language have intimate links at the fundamental level. Further, Chilton described that politics can be defined in the micro and macro view. In the Micro level, politics is a variety of techniques for distributing the persuasion, sharing rational arguments, and talking about irrational strategies done to get the purposes of politics itself. Then, political activities will not exist without using a language. Knowing the language used in the term of politics is necessary. It is needed to understand the language used critically. What is meant by critical thinking skill? Critical thinking is an intellectual activity that needs to be active and fluent to conceptualize. Further, critical thinking is a critical education that students should be responsible and have a good attitude. Critical thinking is defined as knowledge that can be influential in almost every discipline life.

It is associated with the abilities for problem-solving and decision-making. Critical thinking is necessary for students, educators, and other professions in the field of education. It is because based on their research results’ stated that most students in South-East Asia, including Indonesia are considered lacking critical thinking skills. This is a fact that analyzing the Jokowi versus Prabowo’s speeches is necessary as an alternative material for reading skill identified from critical thinking perspectives. Critical thinking is how to think critically and responsible acts that they have done.

3 Method

This is a qualitative descriptive study, particularly it is conducted from political discourse theory. To analyze the data the writer used the theory of qualitative data analysis.

3.1 The data of research

The object of the research is the transcripts of Jokowi and Prabowo Subiyanto speeches in the first Session of President Election Debate. The transcription of the Jokowi and Prabowo Subiyanto Speeches spoken in the 18th January 2018.

3.2 Data Analysis

The Steps of analyzing the data are as follows: the first, reduction the data, it means that in the process of analyzing the data, it is needed to select, to be focused, to simplify and to be an abstract form of transcription. The second, displaying the data, means that the data can be displayed in the form of diagram, chart, or matrix to describe the data. The third, conclusion and verification, means by stepping back to the consideration of what is going to be analyzed and to assess the implication. There are three steps of analyzing the qualitative data, such as; reduction of the text, exploration of the text, and integration of the exploration.
4 Result and Discussion

The data of this study is taken from Jokowi and Prabowo speeches in their first presidential debate conducted on Friday, January 18, 2019. It is written by Jakarta Post. The data is as follows. The first issue is about the President is the chief law enforcement officer. Here is the dialogue between Jokowi and Prabowo about the first issue. “Prabowo said; I would like to empower the national law agencies by involving legal experts to help synchronize national law and local ordinances. Then, Jokowi said; I would place all legislative functions of ministries under the National Legislation Center, directly under the President, to address the issue. Further, Prabowo responded; it was the Government's responsibility to synchronize and create regulations. Then, Prabowo said; President is the chief law enforcement officer, and he is responsible for the implementation of law enforcement” (Jakarta Post).

The first key moment is about law enforcement. Prabowo would like to synchronize between national law and local ordinances. While Jokowi would like to place the legislative function of ministries under National Legislation, directly under the President. Interpreting Jokowi statement, it meant that Jokowi is more powerful, by saying that the law enforcement directly coordinated by the President at the last decision, even the previous process done by the ministries under the National Legislations. Further, Jokowi chose the powerful, significant, and measurable dictions of words. The second key moment was about the corruption that happened in Indonesia. Here is the dialogue between Jokowi and Prabowo. “Jokowi stated; I would like to strengthen the supervision and would like to create transparency for conducting the recruitment process to the civil servants to solve the corruption problem. Prabowo and Sandiaga said; they would like to resolve the root causes of corruption by increasing the salaries of civil servants and law enforcers to prevent corruption. Further, Jokowi responded to Prabowo and Sandiaga, Jokowi said, I disagree. Then, Jokowi mentioned his reasons that the salaries of Indonesia’s civil servants is sufficient, since they also receive performance allowances. Jokowi stressed that it is better to strengthen the supervision, by involving the media and the State Civilian Bureaucracy Commission (KASN) to create a clean government and it is free from corruption”. (Jakarta Post). The second key moment is about the curb of corruption. Jokowi would like to strengthen the supervision and the transparency of the recruitment process. While Prabowo prefers to increase the salaries of civil servants.

Then, Jokowi replied to Prabowo argumentation, Jokowi disagreed to curb the corruption by increasing the salaries of civil servants and law enforcers. Further, Jokowi argued that a high salary is not a guarantee to save the government officers from corruption. Jokowi's arguments are that by doing better supervision and strengthening the Corruption Eradication Commission (KPK) are the key to combat corruption. It meant that Jokowi used the facts and logic and measurable answers. The third key moment, it was about the spaces that Jokowi stopped not giving the response to the Prabowo argumentations.

In this session, “Jokowi said I have nothing to add”. (Jakarta Post). Here, Jokowi to save himself from the Prabowo argumentation, he would like to say I have nothing to add. This is a safe answer rather than to answer the questions that no need more explanation about “law enforcement, human right, and corruption combating. He thought that his answers were enough and carefully to answer the questions. At the fourth key moment, Jokowi and Prabowo created speeches about the corruption combating. Further, the fourth key moment is still about corruption combating. The dialogue between Jokowi and Prabowo is the follows; “Jokowi said
to Prabowo: the Gerindra Party had nominated at least six former graft convicts as candidates in the legislative election, it is taken from the citing of Indonesia Corruption Watch (ICW) data.

Then Prabowo said that the ICW report was very subjective, and Prabowo argued that his party was free from corrupt practices. Then, Prabowo stated, I would send party members who committed corruption to jail. Furthermore, Jokowi responded; there are six ex-graft convicts that you have nominated as legislative candidates. The nomination is signed by the party chairman and secretary-general, which means that you have signed” (Jakarta Post). In the fourth key moment of presidential debate, Jokowi really gave the direct jab to Prabowo. It makes Prabowo really get a deep jab from Jokowi, and it makes Prabowo get high triggers, that is the fact by massaging Praowo’s shoulders to decrease Prabowo’s triggers and Prabowo himself a bit of a dance to make himself calm. Furthermore, at the fifth key moment, Jokowi and Prabowo spoke their speeches about gender.

The dialogue between Jokowi and Prabowo is as the follows; “Jokowi said: the executive board of Gerindra was dominated by males. Prabowo said to Jokowi; the party had a woman deputy chairperson as well as a women’s wing. Our strongest supporters are also mothers. Jokowi responded to the Prabowo statement: my cabinet has nine women serving as my aides in ministerial seats. Prabowo argued; female ministers had issued policies that did more harm than good. Then Prabowo said to Jokowi; you should not be proud of appointing women if the programs had not benefited the people. Further, Prabowo said that Gender should not be the main concern” (Jakarta Post). The fifth key moment is about the gender issue. Jokowi asked Prabowo, that Gerindra was mostly dominated by males. Prabowo argued that Gerindra also has the woman deputy, and the party was supported by the mothers.

Jokowi stated that his cabinet has nine woman ministries. It is the answer to Prabowo. Again, Jokowi gets a factual and measurable answer to argue Prabowo’s statement in the public’s audiences. It meant that Jokowi is more powerful than Prabowo in terms of politics. At the sixth key moment, Jokowi and Prabowo developed their utterances about their supporters. “Prabowo said to Jokowi; law enforcers politically bias because a number of regional leaders who had openly thrown support behind Jokowi-Ma’ruf were free from scrutiny; but a village head in Mojokerto, East Java, was sent to jail after he had declared support for my Party. It violated human rights, particularly freedom of expression. Then Jokowi answered Prabowo’s statement; Jokowi said; don’t accuse us, Pak Prabowo. Further, Jokowi said to Prabowo, We are a country with rule of law, so there is a legal mechanism that we can adhere to. If Pak Prabowo has any evidence, just report it to the [police]” (Jakarta Post). In the sixth key moment, Prabowo described that a number of regional leaders, (Governor) openly had supported Jokowi-Ma’ruf but this phenomena was free from scrutiny. It meant that the regional leaders who supported Jokowi-Ma’ruf are free to express their support. On the contrary a head of the village in Mojokerto who supported Prabowo-Sandi was sent to the jail. In this case, Jokowi replied to Prabowo, powerfully and accurately stating’ if you (Prabowo) have any evidence, just report it to the police. We are a country with rule of Law, there is a legal mechanism that we can adhere to.

Jokowi responds to make Prabowo think based on the fact, but Jokowi is more powerful, he lets Prabowo report the case to the police, if Prabowo has any evidence. It meant that Jokowi (incumbent) candidate is really powerful. He was able to organize the regional leaders to support him, and it was free from the scrutiny. It reflected that Jokowi was more powerful in relation to organizing their supporters systematically. Further, Prabowo argued that one of the head of the village declared to support Prabowo and Sandi, Prabowo said that the head village was reported to the police and he was sent to jail. Jokowi, replied, if you (Prabowo) has the data, Jokowi let him to report to the police, it is as a fact that we are in a country of law, Jokowi said.in this case,
Jokowi also really so his powerfulness to jab the Prabowo’s statement. Then, at the seventh key moment.

It was about human rights. The statement of the seventh key moments is as follows; “Jokowi said that I still committed to resolving the cases. There was no such thing mentioned in your own visions. Jokowi said that it is a report from the military documents, it is in 2014, and it showed that the Indonesian Military’s (TNI) officer’s ethics council had discharged Prabowo for his involvement in the forced disappearances. In Jokowi’s closing statement, Jokowi said to Pak Prabowo, we won’t talk too much, we understand the nation’s problems and what we have to do to address them. Then Jokowi said frankly; we are not dictators or authoritarians. Furthermore, Jokowi said seriously, we do not have a track record of human rights violations, violence or corruption” (Jakarta Post).

The seventh key moment is about human rights. In this case, Jokowi stated frankly, it meant that Prabowo didn't mention this issue in his vision. Further, Jokowi added his statement accompanied by the data, Jokowi said that Indonesian Military’s Officer Ethics has a note that Prabowo had been discharged from TNI, it is because his involvement in the force disappearances, Jokowi stated frankly. Further, in the last statement, Jokowi really gives a deep and factual jab to Prabowo. In the closing statement, Jokowi deeply shows his powerfulness, even though he said seriously, he is still tolerant not to use the pronoun “I” he used the pronoun “we”. It meant that Jokowi was not alone. He was supported by the real partners, he was Prof. Dr. K.H. Ma’ruf Amin. The use of the pronoun “we” really shows his powerfulness including the involvements of his vice-president candidate and his supporters.

5 Conclusion

Related to the data analysis, it is really significant that critical thinking skills are needed by students and any language learners. In this paper, the writer is able to take some meaningful values of critical thinking skills particularly related to the speeches spoken by Jokowi and Prabowo in the first presidential debate. In the seven key moments of the first presidential debates, it shown that the language used by Jokowi is more powerful than Prabowo speeches, even Prabowo gave and argued some Jokowi statements, on the contrary Jokowi gave the deep and factual jabs to Prabowo.

The Jokowi’s jabs given to Prabowo mostly in the every seven key moments. Further, the deepest and the strongest jab was the statement concerning the human rights violations and corruption. Jokowi said that he and his vice-president candidate, his supporters are not dictators, not authoritarian and we don’t have a track record of human rights violations, and no corruption. This statement was supported by the data from the of Military’s Officer Ethics, about the Prabowo involvements of the force of disappearances. That is one of the facts that, in the following debate Jokowi Ma’ruf was able to smoothly do the debates among them. Further, from the seven key moments of the first presidential debate, it was clear that Jokowi-Ma’ruf is the President and vice-president candidate that shows their performances more powerful than the rivals. Then critical thinking is usable to be implemented in any reading skills, one of examples is Jokowi versus Prabowo speeches written in the Jakarta Post, January 18, 2019.
Acknowledgments. The author would like to thank Purworejo Muhammadiyah University, The Rector who has facilitated the process of conducting research and also the Dean of Education and Teacher Training who facilitated my article in the conference. Hopefully, this article will be valuable to all the following researchers.

References


Development of Friction Force Quiz (F2Q) to Support Learning Evaluation on Friction Force Material in Class X SHS

Edi Supriana¹, Salsabila Indana Zulfa², Monica Widyaswari³, Ulya Aziza Fitriya⁴
{edi.supriana.fmipa@um.ac.id¹, salsabilazulfa.1703216@students.um.ac.id², mwidyaswari@gmail.com³}

Abstract. Assessment in the education world has a vital role in measuring students' ability to evaluate the subject matter. The application of computer-based assessments is needed because this is following the conditions of technological development in the education world, which is increasingly sophisticated and diverse. Therefore, this article discusses the development of computer-based assessment products on physics material for class X SHS, namely Friction. This product is a computer-based formative assessment implementation system. This product development aims to make it easier to evaluate this material during the current pandemic conditions. This study uses a Research and Development (RnD) research model by applying the Define, Design, Develop, and Disseminate (4D) model. However, this research is only limited to the third stage, Develop. This product, Friction Force Quiz (F2Q), provides evaluation questions equipped with feedback and different levels of difficulty at each level. The level made in this product aims to determine the level of understanding of the student material. Based on product validation and testing results, this F2Q receives a positive and feasible response if used to support the evaluation of learning in the friction force material for class X SHS.

Keywords: 4D, Formative Assessment, F2Q.

1 Introduction

Physics is a field of science that is generally considered difficult and requires more attention during the learning process. Some of the basic principles of physics are summarized only in simple mathematical form. Apart from understanding concepts through experimentation and analogical processes, learning physics also requires mathematical analysis to find basic principles and predict possible meanings. Although mathematics is not the whole of physics learning, the use of mathematical symbols and the influence of the intuitive language of mathematics in the physics learning process cannot be avoided. Misunderstanding of mathematics and intuitive language will be one of the reasons for the misunderstanding [1],[2].

Friction is an important topic in the study of mechanics [3]. Even though friction is not one of the basic forces, if you understand the concept of friction, the theoretical physics being studied will be more real. In general, many theories in physics are put forward without friction, so they are not suitable for everyday use, such as in free fall, piston motion and
simple pendulum oscillations. Therefore, with the concept of friction, it is hoped that no one thinks the laws of physics only apply to an ideal world in the laboratory. In addition, it also aims to minimize the view that the knowledge learned in school is abstract and far from real life [4].

The topic of friction in learning physics is an interesting topic to study its level of misconception. This is because there are several different conclusions regarding the high misconceptions in friction force. In the research conducted by Lin and Singh, it was concluded that there are several possible misconceptions that will appear in the friction force material. Most students have the assumption that the static friction force is always a maximum value because students have difficulty with the definition of mathematical inequality related to the magnitude of the static friction against the normal force [2]. This is likely due to the vocabulary of introductory physics and how it is interpreted by students. In addition, this evaluation is needed because currently there are many physics books and online learning sites that discuss friction material inappropriately, especially in static friction. These literatures present the mathematical formulation of static friction in general as the maximum value of the static friction force. The implication of using this formula is feared that it can make students interpret the static friction force to be constant regardless of how much force is exerted on an object [5].

Based on the above it is necessary extra effort is needed to understand physics material, especially friction force material. It is because in this material, almost every year, there are students who do not understand and find it difficult. The difficulty experienced by students lies in determining the direction of the force acting on the object [6]. In addition, having no knowledge about the basic concepts of Newton's law is also one of the reasons students have difficulty working on friction force questions [5], [7]. The friction force is a Physics material that is taught to students since elementary school and is further deepened at the first level of high school [8], [9], [7]. At the elementary school level, this material was introduced for the first time to students in the material style section [10].

This material can be delivered in various ways, including using appropriate learning models, using teaching aids in providing simulations, and also providing enrichment questions to students in order to increase understanding [8], [11], [12], [13]. It is in line with the notion that Physics learning requires learning based on understanding the concept through demonstrations or simulations using teaching aids in a pleasant atmosphere [14]. This pleasant atmosphere can be interpreted by delivering material that is fun using a fun learning model and the evaluation is also not boring [15], [16], [17]. One way to do a fun learning evaluation is by giving evaluation questions that are equipped with animations on the discussion of the problem and also a design that attracts students' interest [8], [18]. In addition, educators can also make project assignments a form of evaluation in learning, [19]. Learning evaluation is an activity to obtain information related to students' understanding of the material that has been received [18].

Currently, there are many technology-based learning evaluations and can be accessed easily by students using gadgets [20]. In this material, many learning media have also been developed to support understanding and are easily accessible. However, the learning evaluation developed on this material is only limited to presenting questions. This model can make students bored and lazy to do it, resulting in poor evaluation results [18]. Therefore, in this study, a Friction Force Quiz (F2Q) is developed. It has a collection of questions to evaluate the friction force material which is equipped with feedback on each answer and there is an animation on the discussion related to problem-solving.
2 Method

Research and Development (R&D) is the research method used in this research. It is because this research is engaged in product development. The research model used is the 4D research model. This research model consists of four stages: define, design, develop, and disseminate. Define is the initial stage of a series of stages in the 4D research model, this stage is useful for defining the needs and information needed in this study. At this initial stage, this is a basic step to initiating research, before finally getting the benefits of the results of product development using the 4D research model. While the design stage is the stage that follows up on the results of obtaining initial information or data at the previous stage. The follow-up to this second stage is marked by determining the design that will be used in product development.

Then, the next stage is to develop. This stage is an important step that must be present in the R&D research model. Because this stage is useful for developing products that have been designed and the reasons and benefits for the design of the product are known. This third stage can also be said to be the most crucial stage of a series of existing stages. It is because at this stage, in addition to the product development process, an initial trial process and input from experts is also carried out regarding the feasibility of this product. So, at a later stage, the product that has been developed only requires a response from consumers when using the product.

The final step of the 4D research model is disseminated. This dissemination step serves to disseminate the results of the design of this product to consumers. The intended users for this product are educators and students because the product produced from this research is a product of learning media. Of the four steps in the 4D research model, only three steps were used in this study: only limited to the third stage, develop. This is due to restrictions on the learning process during the Covid-19 pandemic such as today.

3 Result and Discussion

This research produces F2Q products with development stages using the 4D research model. The detailed design of this F2Q product will be presented in the next review. The first review will present the questions or questions that are in the F2Q product. The description of the questions in F2Q is as follows:
At the basic and medium levels, there are types of questions that require an understanding of the concept with a little calculation. The questions at that level use a true and false problem model. So that at this level students are asked to choose whether the existing statement is a true or false statement.
Fig. 3. Question on the third level

Fig. 4. Question on the third level
are presented at the HOTS question level [21], [22]. Not only that, at this level, there is also an answer analysis using three question models. First, the model of true and false questions is the same as the previous level. Second, a multiple-choice question model with more complex questions, and the third one with a short answer question model that only requires a number answer as the key.

At this design stage, besides determining the model and level of questions and levels of the F2Q product, a flowchart of this product is also designed or what is commonly called a flowchart. The flowchart of the F2Q product is as follows:

![Flowchart of the F2Q product](image)

**Fig. 5.** Question on the third level

**Fig. 6.** F2Q product flowchart
This flowchart explains the flow of the F2Q product. When opening F2Q for the first time, students will be given an attractive initial display to make them curious and want to continue to the next slide. It contains a welcome greeting to the world of physics with friction force sub material kinetic friction material and is equipped with an arrow-shaped button to proceed to the next slide. Not to forget, the developer also provides an atmosphere of relaxation to students by adding a piano instrument back sound which can stimulate the work of the students' brains [23].

Fig. 7. F2Q opening product preview

![Welcome to the World of Physics](image)

Fig. 8. Input identity in F2Q product

In the next image, the presentation is displayed regarding the identity input display, homepage, and level homepage, where each appearance has a different nuance. This is built to avoid boredom in students when working on questions [24], [25], [26]. In the identity input display, there are two fields that must be filled in, name and class information. Whereas in Figure 9, the F2Q product homepage displays the F2Q product levels.
The display in Figure 11 shows the questions available on the F2Q product. These questions come from reputable journal articles and physics books which are then developed to suit the level of students in high school. Then in the next display, there is a response slide available from the student's choice of right or wrong. Whereas in Figure 13 shows the display of the score that was achieved when answering the questions. This score slide, not only displays the score you got, but there is also a button to check the discussion of each question which is equipped with an animation related to the question. Figure 15 shows the last slide of the F2Q product display which contains words of encouragement for students and never gives up.
Fig. 11. Question preview on F2Q product

Fig. 12. Answer respon preview on F2Q product
Fig. 13. Score preview

Fig. 14. Discussion of the question preview
After completing the design of the F2Q product, the next stage is to develop the F2Q product. This F2Q product was developed using Macromedia Flash 8 application which can be installed on any Windows software. The choice of an application that is commonly called flash is due to its easy use and relatively comfortable use for novice product developers. At this development stage, input was obtained from experts regarding the mechanism for presenting the discussion of answers and determining levels. Initially, this F2Q product was developed by presenting a discussion of questions after the students chose the answer to the questions. However, according to commentators, the discussion of questions should be put at the end after the score appearance.

In addition, on the homepage display, there is also a change, that initially there was a presentation of material for reviewing the knowledge of students which was eventually eliminated and replaced with a level presentation of the F2Q product levels. Meanwhile, the trial conducted by some undergraduate students of Physics Education at State University of Malang who was currently teaching Computer-Based Assessment courses in 2019 stated that the development of this F2Q product needed to be further developed, so that it could be disseminated more easily.

The research, which begins with the stage of reviewing information from various literature, aims to provide initial information or obtain preliminary data from existing needs in the field. From the results of the literature study, it was found that many students still experienced misconceptions in solving questions. Not only that but students also often find it difficult to do questions, especially questions at the HOTS level. In addition, there are reasons that explain that most students do not understand the basic concept of friction force [27], [28]. The difficulties experienced by students in understanding the basic concepts and solving the friction force problem, among others, are determining the direction of the force and not understanding the concept of Newton's law [6]. Based on the results of the research that had been conducted previously, the data on the test results of students were below the minimum score.

The average score of students' daily tests on friction force material is 38 from the maximum value of 100 [29]. Not only students at the high school level who have problems with friction force material, but university students also often experience difficulties [5]. Based on data obtained from literature study activities, it can be concluded that students need
a tool to improve their understanding of the friction force material [30], [31]. These tools can be obtained from the development of learning media in the form of a collection of questions that can make students understand more about the material. In addition, you can also use a learning model that can push students to better understand this friction force material, such as the Causal-thinking Approach (CTA), Problem-solving Ability (PSA), and inquiry learning models [11], [32]. In addition, it can also use props to help understand basic concepts during practicum [33], [34].

Based on the data on problems and needs obtained from the defined stage, the next stage, design, is carried out by the product design process. The product design of a collection of questions that are equipped with solving this problem is labeled Friction Force Quiz (F2Q). To find out the increase experienced by students in solving problems, this F2Q product has a different problem difficulty level at each level. This F2Q has three levels: the first level with the problem difficulty level at the basic stage, the second level at the medium stage, and the third level at the question difficulty level at the advanced stage. In this third stage, questions are presented at the HOTS level, while at the previous level it is at the level below HOTS or just basic questions that require conceptual understanding.

Programs developed for kinetic friction material are still rarely found, especially programs that provide enrichment questions such as those in F2Q. Most of the instructional media developers in this material are engaged in making tools, such as practicum tools. Meanwhile, enrichment questions generally come from books or a collection of questions provided by the teacher. Using the HOTS level enrichment questions presented in the F2Q program helps students understand the kinetic friction material.

4 Conclusions

This study produces a product that can help support student learning evaluations called F2Q. This Friction Force Quiz is designed not only to help with evaluation activities but also to help provide understanding to students. The F2Q contains a range of enrichment questions from low to high levels. The highest level of questions in the F2Q program is at the HOTS level. Apart from presenting enrichment questions, this program also presents a discussion of questions equipped with interesting animation, this discussion is located at the end of each level. This product is recommended as a complement in delivering the friction force material at the evaluation stage of learning material. Then, this product is only limited to the development, not yet at the dissemination stage. This is because this product is still being developed to make it more perfect so that students can access it in the Playstore. Because at this time, F2Q products can only be disseminated using WhatsApp and Google Drive.

References


27


The Relations Teacher Profession Interest and Teacher Attitudes with Readiness Teaching Students Study Program Office Administration of Education Faculty of Economics Yogyakarta State University

Fitri Handayani Setiyadi, Cepi Safruddin Abdul Jabar, Siti Umi Khayatun Mardiyah {fhsetiyadi@gmail.com, cepi_safruddin@uny.ac.id, umikha@uny.ac.id}

Educational Management, Postgraduate Program, Yogyakarta State University, Jl.Colombo No.1, Karangmalang, Caturtunggal, Depok, Sleman, Special Region of Yogyakarta 55281, Indonesia
Faculty of Economics, Yogyakarta State University, Jl.Colombo No.1, Karangmalang, Caturtunggal, Depok, Sleman, Special Region of Yogyakarta 55281, Indonesia

Abstract. The aim of this research is to understand 1) the relation teacher profession interest and readiness teaching students, 2) the relation teacher attitudes and readiness teaching students, and 3) the relations teacher profession interest and teacher attitudes with readiness teaching students. This research methods using ex-post facto and quantitative approach. The population was all as research subjects totaling 90 students of the study program Office Administration of Education Faculty of Economics Yogyakarta State University class of 2012 (class A as many as 67 and class B as many as 33). A questionnaire (instruments with the help of closed questionnaire guidelines) and documentation are the data collection used in this research. Meanwhile, this research data analysis technique is interactive analysis with three steps as follows validity test, prerequisite test, and hypothesis testing. The results of this research show that (1) there is a positive and significant relations teacher profession interest with readiness teaching is shown by the calculated value of correlation coefficient of 0.638 and significance value 0.000 < 0.05, which means a significant; (2) there is a positive and significant relations teacher attitudes with readiness teaching is shown by the calculated value of correlation coefficient of 0.354 and significant value of 0.000 < 0.05, which means a significant; and (3) there is a positive and significant relations teacher profession interest and teacher attitudes with readiness teaching is shown by the calculated value of coefficient determination (R2) of 0.428 and significance value 0.000 < 0.05, which means a significant with the useful/effective contribution of 42.79%.

Keywords: teacher profession interest, teacher attitudes, readiness teaching.

1 Introduction

Education is an effort to educate the Nation's life. According to law UU No.20 of 2003 concerning the National Education System (Sisdiknas), education is a conscious and planned effort to create an atmosphere of learning and the learning process so that students actively develop their potential to have religious, spiritual strength, self-control, personality,
intelligence, noble character, and abilities, which is needed by himself, society, nation, and state. Education is a process of producing quality human resources.

The world of education cannot be separated from the figure of a teacher. The teacher is the most decisive component in education. Teachers play a significant role in education development, especially those held formally in schools. The teacher also determines the level of success of each student. The teacher is one component of the education sector that plays an active role in increasing adequate knowledge and skills in teacher training following the demands of the times, advances in science and technology. Teachers are the spearhead of the quality of education based on the quality of the teaching and learning process (PBM). The teacher’s function is as an educator, tutor, mentor, trainer, program developer, program manager, and professional staff. Professional teachers must possess teacher duties and functions that describe competencies. Teachers are role models for students, but education/teach students still do not fully have a personality that shows a professional teacher attitude. Students have already received Teaching Professional Ethics courses, but student attitudes still do not reflect a teacher's personality.

Efforts (teacher profession interest) to prepare (teacher attitudes, and readiness teaching students) an educational student are not easy. Students are often late for college, skip the class session, and late submitting assignments. Students bad habits, such as being lazy to read books, underestimate, or ignore the assignments. Students still often copy and paste material from the internet and commit dishonest acts such as plagiarism or plagiarizing friends assignments. Some educational students who do not want to become teachers after graduated and choose to work in office are lazy and tired of preparing complicated teacher administration.

Teaching does not only convey knowledge but values that are used as provisions to instill a religious spirit, independence and responsibility for students. The improvement of teacher skills in preparing and managing the Teaching and Learning Process (PBM) needs to be pursued and prepared for maturity. Based the background of the study, we interested to research The Relations Teacher Profession Interest and Teacher Attitudes with Readiness Teaching Students Study Program Office Administration of Education Faculty of Economics Yogyakarta State University.

2 Methods

The type of study is ex-post facto research because in this study, there was no special treatment or manipulation of the studied variables. The approach used is quantitative. The quantitative approach is used to measure independent and dependent variables using the numbers obtained through statistical analysis (SPSS). This approach is used to test the hypothesis used. For this reason, this study looks for connection the independent variables and dependent variable.

This study population was all students of the Office Administration Education Study Program class of 2012, totaling 90 people (class A as many as 67 and class B as many as 33), all as research subjects. The data was obtained from the information from the Head of the Department of study program Office Administration of Education Faculty of Economics Yogyakarta State University, the website, and the Department Admin, which will be used to obtain students profile data and total of students data class of the 2012. A questionnaire and documentation are the data collection used in this research. This study used research instruments with the help of closed questionnaire guidelines and documentation. This research data analysis technique is interactive analysis with three steps as follows 1) validity test; 2) analysis prerequisite test; and 3) hypothesis testing.
3 Result and Discussion

Teacher profession interest variable data was obtained by filling out a questionnaire consisting of 16 statement items. Based on the calculations, the data is presented with a pie chart, which can be seen in Figure 1 as follows.

![Teacher Profession Interest Pie Chart]

Fig. 1. Pie Chart of Frequency Distribution of Teacher Profession Interest Students Study Program Office Administration of Education Faculty of Economics Yogyakarta State University.

Based on Figure 1, it can be seen that the frequency distribution of teacher profession interest is in the medium category with a percentage of 58.9%. Which mean that not all respondent have a high interest in the teaching profession.

Teacher attitudes variable data obtained by filling out a questionnaire consisting of 10 statement items. Based on the calculation, the data is presented with a pie chart, which can be seen in Figure 2 as follows.

![Teacher Attitudes Pie Chart]

Fig. 2. Pie Chart of Frequency Distribution of Teacher Attitudes Students Study Program Office Administration of Education Faculty of Economics Yogyakarta State University.

Based on Figure 2, it can be seen that the frequency distribution of teacher attitudes is in the high category with a percentage of 81.1%. Which mean that most respondents have a high teacher attitude. Readiness Teaching variable data was obtained by filling out a questionnaire consisting of 15 statement items. Based on the calculations, the data is presented with a pie chart, which can be seen in Figure 3 as follows.
Based on Figure 3, it can be seen that the frequency distribution of the teacher profession interest is in the medium category with a percentage of 68.9%. Which mean that not all respondents have high readiness teaching. The summary of the analysis results can be seen in the following tables.

Table 1. The Results of Correlation Teacher Profession Interest ($X_1$) and Readiness Teaching ($Y$).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cost r</th>
<th>Sig.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Profession Interest ($X_1$)</td>
<td>0.638</td>
<td>0.207</td>
<td>Positive and Significant</td>
</tr>
<tr>
<td>Readiness Teaching ($X_2$)</td>
<td>0.638</td>
<td>0.207</td>
<td>0,000</td>
</tr>
</tbody>
</table>

Source: Primary data that has been processed.

Based on the Table 1, the correlation coefficient ($r_{X_1Y}$) shows that the correlation of the Teacher Profession Interest variable ($X_1$) with Readiness Teaching ($Y$) is 0.638. These results indicate that $r_{count}$ (0.638) > $r_{table}$ (0.207) and a significance value of 0.000, which means less than 0.05 (0.000 < 0.05), so it can be concluded that the relations teacher profession interest and readiness teaching is significant.

Table 2. The Results of Correlation of Teacher Attitudes ($X_2$) and Teaching Readiness ($Y$).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cost r</th>
<th>Sig.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Attitudes ($X_2$)</td>
<td>0.354</td>
<td>0.207</td>
<td>Positive and Significant</td>
</tr>
<tr>
<td>Readiness Teaching ($Y$)</td>
<td>0.354</td>
<td>0.207</td>
<td>0,000</td>
</tr>
</tbody>
</table>

Source: Primary data that has been processed.

Based on the Table 2, the correlation coefficient ($r_{X_2Y}$) shows that the correlation of the Teacher Attitude ($X_2$) variable with Teaching Readiness ($Y$) is 0.354. These results indicate that $r_{count}$ (0.354) > $r_{table}$ (0.207) and a significance value of 0.000, which means less than 0.05 (0.000 < 0.05), so it can be concluded that the relations teacher attitudes and readiness teaching is significant.

Table 3. Multiple Correlation Results.

<table>
<thead>
<tr>
<th>$r_{count}$</th>
<th>$r_{table}$</th>
<th>Sig.</th>
<th>$R^2$</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.665</td>
<td>0.207</td>
<td>0.000</td>
<td>0.428</td>
<td>32.604</td>
</tr>
</tbody>
</table>

Source: Primary data that has been processed.
Based on the Table 3, it can be seen that there is a positive relation the Teacher Profession Interest and Teacher Attitudes with Readiness Teaching Students. The result of $r_{count}$ of 0.655 greater than stable (0.655 > 0.207) and a significance value of 0.000 which means less from 0.05 (0.000 < 0.05). The significance test aims to determine the significance of the correlation Teacher Profession Interest ($X_1$) and Teacher Attitude ($X_2$) with Readiness Teaching Student ($Y$). The significance test used Ftest. Based on the test results obtained the F value of 32.604. When compared with the Ftable value of 3.10 at the 5% significance level, then the $F_{count}$ value > $F_{table}$ so that the third hypothesis is accepted. The Coefficient of Determination ($R^2$) is 0.428 or 42.8%. These results indicate that teaching readiness can be explained by the variables of teacher profession interest and teacher attitudes by 42.8%, while the remaining 57.2% is explained by other variables not examined. Relative Contribution (RC) and Effective Contribution (EC) of each independent variable (Teacher Profession Interest and Teacher Attitudes variables) to the dependent variable (Readiness Teaching variable). The magnitude of RC and EC can be seen in Table 4.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Effective (%)</th>
<th>Relative (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Profession Interest ($X_1$)</td>
<td>31.22</td>
<td>72.95</td>
</tr>
<tr>
<td>Teacher Attitudes ($X_2$)</td>
<td>11.57</td>
<td>27.05</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>42.79</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

Source: Primary data that has been processed.

3.1 The Relations Teacher Profession Interest and Readiness Teaching Students Study Program Office Administration of Education Faculty of Economics Yogyakarta State University

The results of this research, indicate a positive and significant relations Teacher Profession Interest and Readiness Teaching Students Study Program Office Administration of Education Faculty of Economics Yogyakarta State University Class 2012 by the Correlation Coefficient ($r$) of 0.638. Based on the correlation analysis results that have been carried out in this study using Product Moment Correlation Analysis from Karl Pearson, the $r_{count}$ value is greater than the $r_{table}$ (0.638 > 0.207). In contrast, the significance value shows the result of 0.000, which means less than 0.05 (0.000 <0, 05), so it can be concluded that the relations Teacher Profession Interest and Readiness Teaching Students Study Program Office Administration of Education Faculty of Economics Yogyakarta State University is significant, so from these calculations it is found that there is a positive and significant relations teacher profession interest and readiness teaching students.

Teacher Profession Interest is one of the factors related to Readiness Teaching Student. This result follows Andi Mappiare (2012, p.62) who states that "interest is a mental device consisting of a mixture of feelings, expectations, convictions, prejudices or tendencies that lead
individuals to a certain choice.”[2] The choice referred to in this case, is the choice of the teacher profession. Teacher profession interest can arise because of information about the teacher profession, followed by feelings of pleasure and interest in the teacher profession. Furthermore, he/she will pay great attention and raise a feeling of interest in understanding and learning about the teacher profession.

3.2 The Relations Teacher Attitudes and Readiness Teaching Students Study Program Office Administration of Education Faculty of Economics Yogyakarta State University

The results of this research, indicate that there is a positive and significant relations Teacher Attitudes and Readiness Teaching Students Study Program Class of 2012, which is indicated by a Correlation Coefficient ($r$) of 0.354. Based on the correlation analysis results that have been carried out in this study using the Product Moment Correlation Analysis from Karl Pearson, the $r_{count}$ value is greater than the $r_{table}$ (0.354 > 0.207). In contrast, the significance value shows a result of 0.000, which means less than 0.05 (0.000 < 0.05), so it can be concluded that the relations between teacher attitudes and teaching readiness is significant, so from these calculations, it is found that there is a positive and significant relations teacher attitudes and readiness teaching students.

This result is following the opinion of Bimo Walgito (2013, p.16), who states that “attitudes contain a feeling factor and motivation,” which means that the attitude that a person takes towards a particular object will always be followed by certain feelings as well, this can be positive but can also be hostile towards that object.[3] Besides, attitudes also contain motivation, and this means that these attitudes have a strong impetus for individuals to behave in a certain way towards the objects they face. What must be done to foster positive feelings and motivation in developing behavior towards an object, in this case, is that behavior as a prospective teacher needs to be equipped with various teacher sciences as a basis, accompanied by a set of teacher skills training and in that condition learning to personalize some of the required attitudes. A positive and significant correlation of $r_{xy}$ of 0.354 teacher attitudes and readiness teaching students in this research supports the opinion stated above. Therefore, this study proves that the second hypothesis states that there is a positive and significant relations Teacher Attitudes and Readiness Teaching Students Study Program Office Administration of Education Faculty of Economics Yogyakarta State University.

3.3 The Relations Teacher Profession Interest and Teacher Attitudes with Readiness Teaching Students Study Program Office Administration of Education Faculty of Economics Yogyakarta State University

The research results were conducted jointly between the two independent variables and the dependent variable, and there is a positive and significant relations Teacher Profession Interest and Teacher Attitudes with Readiness Teaching Students Study Program Office Administration of Education Faculty of Economics Yogyakarta State University. The results of statistical testing using the Product Moment Correlation Analysis from Karl Pearson obtained a $r_{count}$ value of 0.655, which is greater than stable (0.655 > 0.207), and the significance value is 0.000 less than 0.05 (0.000 < 0.05).

Based on the results of the Multiple correlation analysis in this study, the coefficient of determination shows that the Teaching Readiness variable can be explained by the combination of the two independent variables, namely $R^2$ of 0.428, which means 42.8% of the Teaching Readiness variable can be influenced by the Profession Interest of Teachers and Teacher
Attitudes. In contrast, the remaining 57.2% is influenced by other variables not examined in this study. The calculation of the Relative Contribution of the Teacher Profession Interest variable (X₁) is 72.95%, and the Teacher Attitude variable (X₂) is 27.05%, while the Effective Contribution of each independent variable is 42.79% consisting of the Teacher Profession Interest variable (X₁) 31.22% and the Teacher Attitude variable (X₂) 11.57%.

This multiple correlation analysis result follows the opinion of Slameto (2012, p.59) which states that "readiness is willingness to respond or react. Willingness arises in a person and maturity because means readiness to carry out skills."[10] A person is said to be ready to do a job, and if there is maturity in him to carry out skills, in other words, teaching readiness means a condition or state that is ready or capable so that readiness is defined as a physical and mental development that is perfect or ready to use. So a prospective teaching staff must have the readiness to teach to become a professional educator. Ready in terms of physical, mental, and attitude, which is influenced by the teacher profession interests and the teacher attitudes the prospective educators have. Increasing students teaching readiness cannot be separated from the efforts and cooperation between lecturers and students. There is encouragement from within students to continue to explore their abilities and desire to become professional educators; students willingness to learn will increase teaching readiness.

4 Conclusion

Based on the results of this research can be concluded, the contribution of research results to the scientific field, this research provides information that relations the teacher professional interest and teacher attitudes with readiness teaching students has an effective contribution of 42.79%, but there is still a relations equal to 57.21% from other factors not examined in this study, so it is hoped that further research can use other variables or add variables that have a relations with readiness to teach. Possible give some suggestions as follows teacher profession interest read articles about the teaching profession covering types teacher work, teacher assignments, and matters related to teacher's job, teacher attitudes to seek information about attitudes good teacher like how to dress neatly, show high discipline things that are related to teacher attitudes, and teaching readiness prepare all kinds of things about teaching readiness such as the preparation of lesson plans, syllabus, teaching materials, and media learning. The recommendation of this research can be expected to be input for students that fosters interest in the teaching profession and developing teacher attitudes something that is absolutely necessary for a prospective teacher, in particular in developing the potential for teaching abilities as efforts to improve teaching readiness. Someone being a teacher is a noble job, even though it is a teacher's job full of responsibility, but very useful for Country.

Acknowledgements. We thank all parties for prayer, help, encouragement, motivation so that it is resolved properly and hopefully it is useful for readers.

References


Use of the Quizizz Application in Providing Evaluation of Science Learning in Grade 6 Elementary School Students

Fitria D. Anggraeni1, Sukarno2, Muzzazinah3
{fitriadewianggraeni82@gmail.com1, difficultyno57@gmail.com2, yayan_pbio@fkip.uns.ac.id3}

Postgraduate Student Department Sebelas Maret University, Universitas Sebelas Maret, Surakarta, Indonesia1
Doctoral in primary teacher Education Department, Universitas Sebelas Maret, Surakarta, Indonesia2
Doctoral in Biology Education Department, Universitas Sebelas Maret, Surakarta, Indonesia3

Abstract. Qualified human resources can be obtained through educational programs. The development of science and technology today demands a better quality of education, with the aim of producing educational products that are ready to face the challenges of the globalization era. Evaluation of learning is an important factor as a benchmark to know the expected achievement of learning goals. In achieving these learning objectives, there is a need for various support such as effective learning and evaluation media during this pandemic. Learning evaluation media during this pandemic can be done with the help of online learning evaluation media, one of which is Quizizz. Quizizz application is expected to be the right learning evaluation media, so that it can provide stimulus to increase student learning motivation. The purpose of this research is to describe the use of quizizz application in evaluating science learning in grade 6 elementary school students. The research method conducted is descriptive qualitative research that is expected to know the effect of using quizizz media through recap data of students who have changed from before using quizizz and after using quizizz. The results showed that the average student score before and after using quizizz was from an average student score of 84 to 97. This indicates that there is an increase in student motivation marked by an increase in student grades, after using the quizizz application as an evaluation medium. Based on the results of the study, it can be concluded that quizizz media is an educational learning application media that has better effectiveness in helping the student learning process shown by the grades obtained before and after using the application.

Keywords: Evaluation Media, Motivation, Science Learning, Quizizz

1 Introduction

The Covid 19 pandemic began to hit China since December 2019. China was the first country to be affected by Covid 19. A novel coronavirus, SARS-CoV-2, was identified as the pathogen causing coronavirus disease (COVID-19) in Wuhan, China and has been identified as coming from a Hunan seafood market (Adnan et al., 2020) [1]. On March 11, 2020, COVID-19
was declared a pandemic by the World Health Organization (Muniyappa & Gubbi, 2021) [2]. Many changes have occurred in the world and in Indonesia due to the impact of the virus. This is no exception to change many orders in the world of education. The outbreak of the Covid-19 pandemic has a universal impact on Indonesia's education. Teachers, students, and education staff are all laid off. This effort was taken as a form of prevention of the spread of the Covid-19 virus which has become a global pandemic and continues to increase to dozens of positive patients in Indonesia. This alarming condition is a strong reason for the government to issue various policies so that all teaching and learning activities are carried out from home by utilizing technology tools, and taking policies to negate the National Examination and School Exams (Churiyah & Sakdiyyah, 2020) [3].

2 Literature Review

The policy not only provides an appeal but also some information devices (sites and applications) that can be accessed by schools, teachers, students and parents in facilitating and supporting teaching and learning activities while at home (Churiyah & Sakdiyyah, 2020) [4]. Regarding learning from home, the Minister of Education and Culture emphasized that online/distance learning is carried out to provide meaningful learning experiences for students, without being burdened with demands to complete all curriculum achievements for class promotion and graduation. The Minister of Education and Culture recommends that regions that have carried out learning from home ensure that their teachers also teach from home to maintain teacher safety.

The implementation of distance learning is identical to online learning, this refers to the definition of distance learning which is defined as teaching and learning activities carried out through the use of technology and information in a structured manner in which there is communication / relations between students and students and teachers regularly, substantively, and supportive ((Bozkurt et al., 2015) (5);(Bušelić, 2012) (6); (Grif, 2016) (7)). The implementation of distance learning underscores the absence of physical meetings between students and teachers, this can be replaced by virtual meetings in the form of video shows, presentation of text material, to graphics and images both in real time and delayed (Grif, 2016) (8).

Based on the results of interviews with teachers at SDN 1 Jarakan Tulungagung students experienced a decrease in spirit and motivation in learning during online learning. In fact, learning motivation is also a part that should not be forgotten and underestimated. The lack of motivation student to learn and the lack of student involvement in the teaching environment became fundamental problems in modern education as a result of the digital revolution (Orhan Gökşün & Gürsoy, 2019). Learning motivation is very influential on the quality and quality of learning (Afryansih, 2017).

Low motivation will affect the low enthusiasm and interest of learners in following the learning process. In addition, motivation also has a close correlation with the success learning and achievement of learners. The main factor that most affects learning outcomes is student motivation (Sigala, 2016). Students who have good motivation in their learning activities will be better able to solve problems than to withdraw from the problems faced (Kılıçoğlu, 2018) (12). Students must be motivated to be part of the learning process and be actively involved in it. Therefore, learning motivation is an important thing that should not be ruled out in all subjects. Without exception in science learning in order to achieve the expected learning
objectives, one of which is by selecting the right learning evaluation media, so that student learning motivation is obtained to the maximally. Maximum learning motivation resulting from the learning process that takes place effectively and optimally.

Low motivation to study in school is often indicated by learning problems from these students which can hinder students from understanding the material. This indication occurs because the student's learning factor is less effective, even sometimes the students themselves are lacking in enthusiasm in following the learning in the classroom, causing the students to not understand or understand the subject matter provided. Good learning can be supported by a conducive learning atmosphere and student's relationship with the teacher can run well.

Learning motivation can be seen from the response and enthusiasm of students when participating in learning activities, with the communication of motivation students will be encouraged to learn to achieve goals and objectives, because they are confident and aware of the goodness, interests and benefits. High motivation comes to students who themselves want to achieve great success, in which case the motivation serves to trigger, elicit and direct. Students who are highly motivated students will be enterprising, persistent, unyielding, to improve their achievements. Conversely, if students who are low motivation will seem indifferent, easily discouraged, less eager in following the learning process. The problem that arises is that each student has different motivations, some are high motivation as well as low.

Based on the results of the initial interview with the teacher during the science learning process at SD Negeri 1 Jarakan, before the use of quizizz media, the teacher mentioned that there are stated some problems that occur during the science learning process, including 1) most students are less responding to the presence of the teachers who are explaining the material, 2) when given the assignment, the students were not enthusiastic to immediately collect their assignments, 3) the attitude of the students when teaching and learning activities took place was not enthusiastic. This is thought to indicate that student learning motivation is not optimal. Learning motivation that is still low is thought to be one of the factors that causes student achievement to be not maximal. The problems indicate that the learning motivation of students is still lacking. This is certainly an obstacle in the process science learning in the classroom. In addition, other factors that influence this are in the digital era, such as today students are very fond of online games so that students are less able to develop themselves and lack of concentration on learning in school due to addiction to online game addiction that does not provide learning values for students.

In science learning, an appropriate evaluation media is needed that is expected to be useful for teachers and students in particular, helping students in increasing their learning motivation. Moreover, the development of science and technology at this time demands a better quality of education, in order to produce educational products that are ready to face the era of globalization. Every individual involved in education is required to play a maximum role in improving the quality of education. One of the cores of quality education lies in the learning process in the classroom, therefore teachers must have strategies in improving student learning n order to create a quality education that is in line with mutual expectations. The existence of learning evaluation media is one ways that teachers use to achieve success in learning activities. It can be useful to support the improvement of student learning motivation. This increase correlates with the increase in the evaluation value of students. The existence of an increase in student motivation to learn is expected to provide improvements to student achievement in school.

The use of appropriate and appropriate evaluation tools can improve student learning experiences and can make students more enthusiastic about learning. One form of learning evaluation media that can cause students to be excited about learning is learning media in the
form of games (Agustiya et al., 2017) (13). For example, through the use of educational game applications, namely Quizizz. One of the IT-based learning evaluation media is a web tool for creating interactive quiz games that can be used as learning media. The use of online evaluation media is supported by developments in cellular technology in recent years that have allowed changes to occur, among them namely student mobile device integration or teacher to educational practice (Moqbel, 2018) (14). So quizizz is the best alternative option that is used as a learning medium available in mobile applications such as Android and app stores and can be used as a website through a browser on a computer (BAL, 2018) (15).

Quizizz is also a game-based educational app, which brings multiplayer activities to the classrooms and creates them fun in interactive and fun training classes. With Quizizz, students can practice in class on their electronic devices. Unlike other educational apps, Quizizz has game characteristics such as avatars, themes, memes and entertaining music in the learning process. Quizizz also allows students to compete with each other and motivate them to learn. Students take the quiz at the same time in class and see their live ranking on the leaderboard. Instructors can monitor the process and download the report when the quiz is over to evaluate student performance. Using this application in accounting classes helps stimulate student interest and increase student engagement (Zhao, 2019) (16).

The integration of web-based games or learning with mobile assistance is beneficial for teachers and students to make the teaching and learning process more effective (Moqbel, 2018) (17). Apart from increasing student motivation and autonomy, these technological means also facilitate students to carry out self-assessments by making use of the instant feedback and reviews offered (Wang, 2008) (18). Quizizz is also a mean of application in the form of interactive quizzes that are considered capable of attracting students’ interest because it replaces the old way of quizzes that only involve paper and pens but in the form of questions made by teachers in quizizz.com to be done by students by entering the join code. The student joins by opening the quizizz.com application app and entering the game code along with their name and can be used without the help of a projector because players see the question and answer options on their own layer. The order of the questions is randomized for each student, making it not easy for players to cheat.

Agreeing with this, quizizz is an online assessment tool as a fun multiplayer classroom activity that allows all students to practice together with their computers, Smartphones and I Pad (Yan mei et al., 2019) (19). Its use can be accessed via cell phones, so students can take advantage of technology positively and can increase student motivation in learning. In addition, the features available in quizizz can also make it easier for teachers to evaluate the learning that has been delivered and this feature also makes it easy for the assessment process to be downloaded in formal excel.

Quizizz is also an online evaluation media that can be used to conduct formative assessments. Formative assessment (Assessment for learning) is the process of collecting data on the extent of students' progress in mastering competencies, interpreting the data, and deciding effective learning activities for students in order to master the material / competence optimally. Formative assessment involves teacher and student activities that aim to monitor student learning progress during the learning process. This assessment will provide feedback for improving the learning program, knowing and reducing errors that require improvement. Formative assessment plays an important role in both traditional learning environments and e-Learning environments. Many researchers have observed that the effectiveness of student learning can be increased if the e-Learning environment includes a Web-based formative assessment design (Buchanan, 2000) (20).
This research is supported by research conducted by Purba which is a descriptive qualitative research to find out the increase in student learning concentration through the utilization of quizizz learning evaluation in chemistry physics course I. The results of data analysis obtained from the pre-test and post-test showed an increase in student learning concentration through the use of quizizz learning evaluation in Chemistry Physics I course by 0.45 with moderate improvement interpretation. Based on in-depth interviews with students used as sampling, accuracy increased due to time constraints and students' fear of the response of answers inputted by students on quizizz. Learning evaluation using quizizz helps improve students' learning concentration (Purba, 2019) (21).

In line with this statement, research by Albeta et al. is a research on ICT-based tournaments with the quizizz application that plays a role in learning chemistry. This role is seen from the aspects of motivation and student learning outcomes. This type of research is a quasi-experimental design "The randomized pre test - post test control group design" and data analysis uses the t-test to compare the control and experimental classes. Learning that implements ICT-based tournaments with the quizizz application can increase motivation and learning outcomes. Students feel motivated to be the best. The existence of a tournament with the quizizz application makes learning fun, not boring and the concept of subject matter easier to master (Albeta et al., 2020) (22).

Based on some of the previous research using quizizz learning evaluation media, but there are some differences with this study, namely (1) in the previous research subjects were students, while this research was on elementary school students, (2) previous research media evaluation quizizz learning is used for chemistry and physics subjects, while in this research developed for science subjects Elementary School, (3) previous research used a qualitative research approach.

The description that has been stated above, researchers argue that it is important to conduct research related to the use of media in science learning in elementary school. Based on the observations have been done in Elementary School 1 Jarak, Tulungagung, if using quizizz media as a learning evaluation tool students will be more eager to learn to master the learning materials delivered by the teacher so that students can get the highest score when using quizizz media as an evaluation tool. Therefore, based on this explanation, the researcher is interested in conducting a research entitled "The Use of Quizizz Application in Providing Evaluation of Science Learning in Grade 6 Elementary School Students".

3 Method

This research is a descriptive qualitative research. Qualitative research places researchers as a key instrument (researcher as key instrument), which means that qualitative researchers must collect their own data through documentation, behavioral observation, and interviews with participants. Therefore, researchers must have a broad range of theories and insights so that they can ask, analyze, and construct the objects studied more clearly.

The form of research used in this research is descriptive. This research was conducted in elementary schools in Tulungagung district, namely SDN 1 Jarak, Tulungagung. Data collection techniques used in this study were interviews, observation and documentation. The analysis technique used in this research is an analysis technique that uses an interactive analysis model. The selection of this method is because this research is descriptive qualitative where the tipping point is deep information digging, describing and explaining, exploring and interpreting, so that the use of this model will support that goal. The interactive analysis model has four
components: data collection, data reduction, data presentation, and inference and drawing conclusions.

4 Results and Discussion

The teacher is the main key to successful learning, as teachers that will affect students' lives. The teacher understands that each student has their own character, as well as musical instruments such as the flute, guitar, for example, have different sounds. How each character can play a role and bring success in learning. The teaching and learning process is a complex phenomenon, everything means every word, thought, action, and association and the extent to which teachers can change the environment, presentation, and teaching design, the extent to which the learning process takes place. Teachers must be able to take students into the world they will teach and give our world to students.

The learning process will run well if it using sequence or rules that have been prepared before learning is done. The teacher determine suitable learning strategies for students. All learning activities are listed in the lesson plan. After observing in grade 6 of Elementary School 1 Jarakan Tulungagung Regency, that the grade 6 teacher of Tulungagung Elementary School 1 Distance has used the lesson implementation plan and innovative learning evaluation media that is suitable for students, because learning can allow students to think critically, this is in accordance with the approach taken by the teacher is a inductive approach.

The evaluation media used by teachers in Elementary School 1 in science learning is Quizizz media. The quiz media is used by the teacher as a step to motivate students in learning. Especially in today's millennial era, children have difficulty working from using cellphones. Media Quizizz is a web tool for creating interactive games used in classroom learning. The interactive quiz created has up to 4 answer options including the correct answer and pictures can be added to the background of the question. When the quiz is over, we can share the code with students so students can enter the quiz.

Based on the results of observations, 16 students from grade 6 showed positive responses during learning using quiz media. This can also be seen from the enthusiasm shown by the students. This is supported by the teacher evaluation scores before and after using quizizz. The values are illustrated in the table below:

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of student</th>
<th>Before using quizizz</th>
<th>After using quizizz</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Nizar</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>2.</td>
<td>Berly</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>3.</td>
<td>Dava</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>4.</td>
<td>Arin</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>5.</td>
<td>Indira</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>6.</td>
<td>Ikhsan</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>7.</td>
<td>Faza</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>8.</td>
<td>Akbar</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>9.</td>
<td>Ivory</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>10.</td>
<td>Rafika</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>11.</td>
<td>Dandi</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
Based on the table, there was an increase in the average grade of students before and after using the quizizz. The previous student evaluation scores averaged 84 to 97. It showed an increase in student grades before and after using quizizz evaluation media. Based on the data it can be know that there is an increase in student motivation which is marked by an increase in student grades, because after using the quizizz application students are more enthusiastic to compete and get better grades with their classmates.

The mobile learning environment changes the monotonous way of teaching in the classroom whereby the students are only listeners. In traditional education, only one way communication exists in face-to-face lectures. The teachers tend to teach unilaterally, it is important to promote interactivities among students and between the teacher and students. Traditional education is passive, lacks interaction and sometimes complicated contents are hard to be taught and understood. Poor communication between students and the teacher is one of the major problems in learning (Tabata et al., 2009) (23). However, mobile devices can aid in reducing this problem and improve interactive communication to help increase the motivation of the students (Kopf et al., 2005) (24). Many studies have examined the use of wireless mobile devices in learning. According to (Roschelle, 2003) (25), “90% of teachers in a study of 100 palm-equipped classrooms reported that handheld was an effective instructional tools with the potential to impact student’s learning positively across curricular topics and instructional activities.”

Quizizz is a website that provides teachers to conduct formative assessments by giving quizzes for students of all ages. According to (26) quiz is a test of knowledge that has been obtained first, especially as a competition in the form of a game. Even though it was like a competition, the tests were entertaining. Quizzes are typically used multiple choice questions that are quick and easy to assess student answers (Tabata et al., 2009) (27) and quizzes provide questions at various levels of difficulty (28). Furthermore, students will report their answers (feedback) is given directly, automatically.

Quizizz provides multiplayer activities that allow students to practice together. The total number of players who will take the quiz is determined by the teacher. Students will be given a code to join the quiz and the teacher will make sure the students taking the quiz with the student attendance register to avoid intruders. So, not everyone can take this quiz. Quizizz supports all devices such as computers, smartphones and tablets, and quiz also has iOS, Chrome and Android apps. As a result, it can be reached in an era where technological developments are very impressive. Most students have smartphones or laptops with good internet connections that can be accessed by them to take quizzes. However, students must have their own device in other words one student, one device (Pitoyo et al., 2019). Quizizz's main features include:

1. Student-paced: the teacher will give a time limit for each question and students need to answer before the time given for each answer is up.
2. BYOD: quizizz can be played in various devices with a browser, including PCs, smartphones, laptops, tablets, and.
3. Thousands of public quizzes: a great number of teacher around the globe create their own quiz and it can be shared, thus everyone can do the quiz as long as they are a member of
quizizz. It is really helpful for the teacher to get some inspiration from another teacher in designing the quiz.

4) Quiz Editor: quizizz allows the teachers to pluck questions from any quiz, easily add images from the internet, auto-save teachers' progress and tons of other features.

5) Reports: this feature is the one which can give teachers detailed information about student-level understanding and class-level for each quiz that teachers conduct. The teacher can also download the report in the form of a spreadsheet in Microsoft Excel.

6) Quiz Customization: Teachers can customize their quiz session in multiple options to consider the level of competition, speed, and other factors. There are also settings including question and game which teachers can use to create a quiz that they want or represent teachers' goal.

Learning evaluation media that can be created and utilized from quizizz application is interactive multimedia. This quizizz has advantages that can be used as a learning evaluation media, for example, there are data and statistics on student performance where the results can be used as material for evaluation of follow-up learning. Another feature in the form of this media is used as a medium for learning at home, namely homework (PR) which can provide opportunities for students to study outside the classroom, namely in virtual classes which are

![Figure 1. Questions settings of Quizizz (Source: Pitoyo et al., 2019)](image-url)
also a place to learn while playing with this media. Games that are creative, innovative, challenging, and fun will foster positive motivation for learners' learning desires.

Learning contents that has been prepared by designers that educators can easily find on Quizizz. This is the need for teachers to know how to make Quizizz media so that it can be used for learning for students. Learning evaluation media with Quizizz application is very easy to make by first preparing the material in the form of questions and alternative answers in this Quizizz online application. Once ready with the content, please enter the application on the web, namely www.Quizizz.com.

The way it takes to create and take advantage of this Quizizz media is to start opening the web, which is the one at that address before. For newcomers or who don't have an account, you can create a Quizizz account by registering yourself by signing up on the website, then completing the registration. If you have registered, you can use the account to log into Quizizz and then log into the web by filling in your email and password. If you have entered the web, you will be faced with a library with a collection of quiz media that has been made by the previous quiz maker. Then choose the available quizzes for students to use to study, make homework, or practice independently by selecting according to their needs.

The steps are to prepare a set of questions for the creative quiz content. Then open the application and input the questions that have been prepared. When finished, please publish it so that it can be used not only for yourself but by others as well. Thus the resulting media variations can be more widely distributed by the use of Information and Communication Technology (ICT) in learning. The use of the Quizizz application that can produce learning evaluation media can then be developed by understanding how to make it and using it in learning. Learning evaluation media generated from quizizz application can contribute to learning with expected results for improvement of learning outcomes. Now we'll take a look at the Quizizz app. Quizizz for learning various subjects and levels already exists. We can see this from the works on Quizizz.

Quizizz is a learning evaluation media in the form of online media to create a material exposure in the form of interactive quizzes enriched with animations and interactions that are very interesting and also easy to use. This application can be accessed on the site www.Quizizz.com. Figure 1. Home of Quizizz We can get Quizizz works that have become so many because they have been posted so many times on the site. However, it would be better if educators create their own creation because it can adjust to the learning needs of their students according to the learning objectives designed. If you have found the quiz set you need, you can use it by making it a live, solo or homework in our virtual classroom. This is if we take advantage of the existing ones, if not then we have to make our own quiz sets. This Quizizz application has features that have been programmed by its designers which are also designed to be easy to use by its users. Visual and audio elements are also included in this application.

The completeness of the Quizizz application is very supportive for the success of learning at various levels and subjects. The development and utilization of learning evaluation media is needed to complement things that are still incomplete at the time of making and utilizing applications because they are related to the learning needs of students. The development of instructional evaluation media that can accommodate learning at various levels and levels will be very supportive to be developed by educators and further utilized by students in increasing their competence.

As previously mentioned, the Quizizz application is an online application service that can be developed into a learning evaluation media that is rich in advantages that can be used in learning various subjects and levels. Furthermore, the learning evaluation media produced from the Quizizz application is how to use it in order to meet the needs of learning evaluation media starting from the elementary school level.
There are still many educators who teach the various maples and levels of Quizizz who do not understand both their manufacture and use. This existing condition should change with an increase in the understanding and skills of educators to create and use Quizizz as a learning evaluation medium so that educators can improve their insights, knowledge, and skills in making Quizizz-based media as a learning evaluation media in this digital era. Educators are expected to be more creative in their work and also select existing learning evaluation media and follow up with the use of media.

5 Conclusion

The Covid-19 pandemic has had an impact and demanded changes in a limited time including the impact on educational aspects in the form of changes in distance online learning models that tend to be less effective in increasing students' interest and motivation for learning. This explains that it needs effective media in evaluating and learning students in order to achieve the expected goals, the application is quizizz. The results of the research that has been done in grade 6 students at SDN 1 Jarakan Tulungagung in the form of literature studies and interviews with student teachers obtained data that the learning using the appropriate learning plan and evaluation media and supported by quizizz application received a positive response. Based on the document of student value recap from the teacher shows that there is an increase in the average value of students before and after using quizizz. The previous student evaluation score averaged 84 and after using quizizz to 97. The data showed that there was an increase in student motivation marked by increased grades, and a good response in the form of a high spirit of learning through application-based supporting media. With the development of educational technology becomes an important role that can be used to build quality human resources and have good digital literacy. This will have an impact on the readiness of distance learning systems in all situations.

References


Biocompatibility Test of Ceramic Materials in Zebrafish Development

Husnul Budiatman Dani¹, Ika Dewi Ana², Bambang Retnoaji³
{husnul.budiatman@mail.ugm.ac.id¹, bambang.retnoaji@ugm.ac.id³}

Faculty of Biology, Universitas Gadjah Mada, Jl. Teknika Selatan, Sekip Utara, 55281, Yogyakarta, Indonesia¹, ³, Faculty of Dentistry, Universitas Gadjah Mada, Jl. Deta 1, Sekip Utara, 55281, Yogyakarta, Indonesia²

Abstract. The use of dental implants, which be implanted directly into bone is one of the major advances in modern dentistry. One of the dental implants that have recently been proposed is bio-ceramic. One of the prerequisites for the use of bioceramic is biocompatibility, which means being able to interact and connect with living tissue and the physiological environment without causes any adverse effect on the tissue. Zebrafish (Danio rerio) are known as model organisms that have similarities with humans such as the composition of bones, bone cells, and molecular signaling. The purpose of this study was to determine the effect of various bio-ceramic concentrations exposure to the structure of zebrafish bone tissue. The research was conducted in the laboratory of animal structure and development, Faculty of Biology, Gadjah Mada University. Fertilized zebrafish embryos were chosen and exposed to specific concentration of a ceramic material solution on the well plate, as follows 250µg, 500µg, and 750µg for a period of 72 hpf. One-way ANOVA test was used to assess the significance (P<0.05) of the control treatment results and various bio-ceramic concentrations. The results showed no effect of bio-ceramics (CHA-Ag) on survival rate, hatching rate, and heartbeat rate per minute at all exposures. However, some embryos and larvae at the age of 24-72 hpf concentration of bio-ceramics exposure 750µg, indicating were morphological changes such as egg yolk deformation, malformations of the spine, tail, and caudal fin, and stunted body or eye growth.

Keywords: biocompatible, bone, ceramics, dental implants, zebrafish.

1 Introduction

The use of dental implants, which be implanted directly into bone is one of the major advances in modern dentistry. Dental implants can provide better comfortability for patients in the healing function after tooth loss [1]. Implants are recognized as having the ability to heal and maintain epithelial and connective tissue around the implanted area. Functionally, dental implants rely heavily on osseointegration around the implant [2]. The characteristics required for dental implants are biocompatibility and functionality in tissues [3].

Some of the materials that have been studied for use as dental implant materials are metals, alloys, ceramics, polymer-based materials, glass, and carbon. However, ceramics are considered a promising material in the future. Ceramic materials are used as implant biomaterials because they have the same bone mineral components, biocompatibility, and osseointegration with human tissue. Bioceramics are ceramic materials commonly used in the manufacture of implants...
and orthopedic application devices which function to repair and replace diseased and injured parts in the human body [4].

Ceramics material for medical purposes is referred to as bioceramics, containing inorganic or non-metallic compositions in the form of hydroxyapatite $\text{Ca}_{10}(\text{PO}_4)_{6}(\text{OH})_2$ (HA). HA can support cell migration and angiogenesis resulting in the formation of new bone during tissue repair [5]. HA is biocompatible, osteoconductive, non-toxic, non-inflammatory, and is not an immunological agent. Also, HA is bioactive or can bond chemically with living tissue in humans [6]. HA-related material is carbonate hydroxyapatite $\text{Ca}_{10-x}\text{Na}_x(\text{PO}_4)_{6-x}(\text{CO}_3)_x(\text{OH})_2$ (CHA) which is believed to be more promising because it has a more accurate chemical composition approaching one of the inorganic parts of bone tissue and has a fairly high biosorption rate [7]. A recent study conducted a combination of CHA with Ag, the mixture shows an antibacterial also non-toxic effect [8].

The bioceramics used in this study were made from silver-coated coralline hydroxyapatite (CHA-Ag). This material has antibacterial and biological properties because it has major components such as calcium, phosphorus, oxygen, carbon, and silver. The presence of antibacterial properties is caused by positively charged Ag$^+$ which can bind and stick to negatively charged bacterial surfaces due to Kuhn's gravitational force. After damaging the bacterial cell wall, Ag$^+$ then enters the cell and immediately reacts with lysine, arginine, and other chemical compounds, causing the active protein to freeze and the activity of the bacterial metabolic enzymes to decrease. Compared to the structure of CHA, the new material, CHA-Ag is believed to have the advantage of being able to maintain the 3-D porous structure so that it has benefits for the structure and composition of bone conduct [8].

Preclinical in vivo studies in clinically relevant animal models is a fundamental step in research. The use of larger-sized animals has a limited cost, care, and complex ethical issues [9]. The in vivo model using the Zebrafish (Danio rerio) has recently undergone a development. Zebrafish and humans have similarities in genes homologous, genome, anatomy, physiological, cardiovascular, nervous, and digestive systems. Zebrafish can be used to evaluate the in vivo toxicity of degraded particles from newly developed biodegradable metal implants which can accelerate the material development process to clinical application, and avoid the ethical considerations associated with using mammals as a research tool [10]. In this paper, we identify the biocompatibility properties of ceramic material silver-coated coralline hydroxyapatite (CHA-Ag) using zebrafish as an animal model.

## 2 Materials and methods

### 2.1 Places of Research

The research was conducted at the Laboratory of Animal Structure and Development, Faculty of Biology, Gadjah Mada University in October-November 2020.

### 2.2 Zebrafish maintenance and egg collection

The animal used in this study was the Zebrafish (Danio rerio) Wild Type from University of Leiden. Zebrafish were maintained in standard conditions, on a cycle of 14-10 light-darks with a temperature of 27-28.5 and dissolved oxygen around 6-8. The fish were kept until they were ready to spawn. The spawning was arranged females and males ratio of 2:3. The eggs were collected and selected to determine the normal zygote, which were used in the experiment.
2.3 Preparations of ceramic materials

The ceramic material used in this study is made of CHA-Ag. The medium used was egg water solution. The ceramic material was prepared with three concentrations of 0.05 gr/ml, 0.1 gr/ml, and 0.15 gr/ml in egg water, respectively.

2.4 The embryo exposure

The 120 selected embryos were grouped into four treatments: control, CHA-Ag of 250μg/200ml, 500μg/200ml, and 750μg/200ml. with three replication each. The ceramic material solution was added to each well plate treatment, and 10 embryos were placed in each plate hole. The period of fish exposure time on the ceramic solution was 72 hours. Biocompatibility assessment were evaluated base on parameters as follows: Hatching rate, survival rate, morphological characteristics, and physiological changes of the fish, which be compared with the control group.

2.5 Post-exposure maintenances

The larva was reared at 20x30 cm aquarium. Water quality management was carried out by maintaining water following standard for zebrafish media. Debris and dirt were regularly removed to maintain water quality.

2.6 Preparations

One month of old larvae were sacrificed and processed for bone staining preparations Alizarin Red S. Alcian Blue (ARAB).

2.7 Data collections

Control and treated embryo were observed with a Leica DM750 microscope to determine their morphological shape, muscle contraction, and heart rate. Embryo development was observed every 6 hours. Morphological and physiological observations of larvae were carried out once a day by observing each change and compared with the control group. Morphological parameters include pigmentation, body size ratio, and organogenesis, and organ completeness in the embryo. Physiological parameters include swimming activity, feed response, and swimming ability.

2.8 Statistical analyses

Data were statistically analysed with IBM SPSS Statistics 21. One-way ANOVA test was used to determine differences between treatment groups of various concentrations of ceramic material. Data were presented as mean standard deviation and were considered significant if P <0.05.
3. Results and Discussion

3.1 Effect of the ceramic material on embryo survival rate

Fish embryos were monitored for 72 hours of the total exposure period. The embryo morphology in each treatment group is shown in Figure 1. Specifically, compared to the morphology of the control group, the head was smaller, and the tail was bent after CHA-Ag treatment (figure 1 D). Despite the development defect and morphological abnormalities, which clearly observed in the embryo, the heart rate in the embryo and larvae still actively continued to occur.

![Figure 1](image1.png)

**Figure 1.** The phenotip of fish embryo and larvae which were exposed to CHA-Ag for the period of 72 hours. A control, B concentration of 250 µg, C 500 µg, and D 750 µg.

![Figure 2](image2.png)

**Figure 2.** graph of zebrafish embryos survival rate (%) of control and which were exposed to CHA-Ag concentrations of 250 µg, 500 µg, and 750 µg for 72 hours.

The effect of CHA-Ag on embryos presented in figure 2 showed the number of survivals at 24 hpf of each treatment. The number of embryo survival on control 96%, concentrations of 250µg was 90%, 500µg was 97%, and 750µg was 97% respectively. The Prolong period
exposure of 48 and 72 hpf showed the tendency of lower survivability of larvae. Moreover, lower survivability percentage was showed by the embryos and larvae treated with 750µg for the period of 48 and 72 hpf of 83% and of 77%.

### Table 1. The effect of CHA-Ag concentration on zebrafish embryos survival rate at 72hpf.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Average (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>97&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>CHA-Ag 250µg</td>
<td>90&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>CHA-Ag 500µg</td>
<td>93&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>CHA-Ag 750µg</td>
<td>77&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Exposure of embryo with CHA-Ag for period of 72 hours showed that the lowest survival rate of zebrafish embryos and larvae occurred on the treatment concentration of 750 µg with 77% of embryo survived. This corresponds to the presence of several embryos/larvae which were deformed during development due to high concentrations of ceramic material (Figure 1). However, the analysis result showed that survival percentage of control embryos and exposure to CHA-Ag were not significantly different (p <0.05).

#### 3.2 Effect of the ceramic material on embryo hatching rate

![Figure 3. Zebrafish embryos exposed to ceramic material at 24 hpf. A control embryo, B the embryo at concentration of 250 µg, C 500 µg, and D 750 µg. Hindbrain (Hb), Corion (C), Eye (E), Tail region (Tr), Yolk (Yo), Somite (S).](image)

The hatching rate is one of the important indicator to estimate the developmental progress of zebrafish embryo. The normal hatching period for zebrafish embryos is between 48 to 96 hpf [11]. The zebrafish embryo is surrounded by chorion layer during the pre-hatching stage (figure 3). The chorion is a layer that surrounds and protects the zebrafish embryo as a barrier from external stimuli. The presence of chorion can affect the level of chemical contact with the
embryos and their subsequent biological responses [12]. According to [13] this layer serves as a protection for the embryo which blocks the accumulation of particles due to surface charge interactions. The zebrafish chorion has pores 0.5–0.7 µm in diameter required for the transport of oxygen and nutrients to the embryo, so the chemicals that can enter the chorion are only smaller than the pores[14].

![Figure 4](image-url)

**Figure 4.** Hatching rates (%) of zebrafish embryos were exposed to CHA-Ag concentrations of 250 µg, 500 µg, and 750 µg for 48 hours.

Embryos were exposed to ceramic materials until they become larvae for 72 hours. The embryo hatchability of 36 hpf, the control was only 3%, the CHA-Ag concentration treatment was 250 µg 60%, 500 µg 37%, and 750 µg 27%. Whereas in the treatment of 42 hpf the hatchability of the embryos in the control treatment increased rapidly by 57%, the treatment concentration of CHA-Ag 250 µg 87%, 500 µg 97%, and 750 µg 83%. At 48 hpf control treatment 97%, CHA-Ag treatment 250 µg 90%, 500 µg 97%, and 750 µg 83%, all embryos incubate at 48hpf. Figure 4 shows.

**Table 2.** Effect of ceramic material (CHA-Ag) on hatching rate of zebrafish embryos at 48 hpf.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Average (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>97&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>CHA-Ag 250µg</td>
<td>90&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>CHA-Ag 500µg</td>
<td>97&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>CHA-Ag 750µg</td>
<td>83&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

The statistical analysis was carried out in Table 2, it showed that the treatment of all concentrations of ceramic materials had not significantly different (P <0.05) with control at 48 hpf. All embryos hatched at 36 - 48 hpf, this indicates that the embryo was developing normally.
This follows the statement [15] Zebrafish embryos begin to hatch at 48 hpf and finish hatching at 72 hpf in normal condition.

3.3 Effect of the ceramic material on the heartbeat rate (per minutes)

![Heartbeat rate (per minutes) of embryos and larvae](image)

Figure 5. Heartbeat rate (per minutes) of embryos and larvae were exposed to CHA-Ag concentrations of 250 µg, 500 µg, and 750 µg for 72 hours.

Graph showed that the embryo and larva heart rate of 48 hpf, the control was 159 beats/minute, concentration of 250 µg 180 beats/minute, 500 µg 174 beats/minute, and 750 µg 172 beats/minute, while the 60 hpf embryo showed that the control treatment heart rate was 168 beats/minute, concentrations 250 µg 164 beats/minute, 500 µg 162 beats/minute, and 750 µg 166 beats/minute, and the 72 hpf embryos heart rate in control 192 beats/minute, concentrations of 250 µg 194 beats/minute, 500 µg 199 beats/minute, and 750 µg 190 beats/minute. Decreased heart rate at 60 hpf and an increase of 72 hpf is indicated because the activity of the cardiomyocytes begins to peel off the ventricular wall to initiate trabeculation and complete at 72 hpf [16]. According to [17] the zebrafish heart rate has increases with embryo development to ensure perfusion in all developing embryonic tissues. In a study [18] the abnormal phenomenon in zebrafish exposed to the chemicals diphenoconazole and cyhalofop-butyl had a teratogenic effect and caused a weakened heart rate.

Table 3. Effect of ceramic material (CHA-Ag) on the heartbeat of embryos and zebrafish larvae 72 hpf.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>192a</td>
</tr>
<tr>
<td>CHA-Ag 250µg</td>
<td>194a</td>
</tr>
<tr>
<td>CHA-Ag 500µg</td>
<td>199a</td>
</tr>
<tr>
<td>CHA-Ag 750µg</td>
<td>190a</td>
</tr>
</tbody>
</table>

Table 3 shows that the results of the analysis showed that the heart rate ratio of embryos and zebrafish larvae was not significantly different (P < 0.05) between the control treatment with
the ceramic material treatment of all concentrations. In general, the normal heart rate of the embryo and larvae of the zebrafish 72 hpf is around 120-180 bpm [19].

3.4 Effect of the ceramic material on the morphology of zebrafish larvae

![Comparison morphology of the larvae which were exposed to CHA-Ag for the period of 66 hpf. A control, B, C, and D concentration of 750 µg. Tail Malformation (TM), Yolk Not Depleted (YND), Pericardial Edema (PE) Ocular Edema (OE), Bent Spine (BS), Submandibular Edema (SME).](image)

For the assessment of the toxic properties of ceramic materials in zebrafish, qualitative morphological observations were to determine the changes in zebrafish morphology because of the concentration of CHA-Ag and treatment time. After being treated with various concentrations of CHA-Ag, zebrafish embryos can be assessed based on the severity of their morphological defects. In Figure 6 zebrafish aged 66 hpf, part A shows no visible toxic effects and D shows severe defects and is not fully developed. Sections B and C indicate defects that are not severe or moderate.

Developmental disorders can be characterized by a non-depleted or deformed egg yolk; malformations of the spine, tail, and caudal fin; formation around the pericardial sac or yolk; delay of hatching; stunted body or eye growth; damaged and opaque tissue; chorionic excretions that are characterless; and edema in the body cavity, pericardial sac, or yolk sac region [20]. According to [21] developmental abnormalities and teratological effects that occurred in zebrafish embryos and larvae after exposure to chemicals resulted in reduced heart rate, reduced blood circulation, notochord deformities, pericardial edema abnormalities, and yolk sac deformity in the early stages of zebrafish life.

3.5 Zebrafish larvae bones structure

Zebrafish is an ideal alternative vertebrate model for studying and skeletal malformations [22]. Based on this, we observed the bone structure using the Alizarin Red S. Alcian Blue (ARAB) staining method on zebrafish aged 30 days after being exposed to ceramic material for 72 hours. The Alizarin Red S. Alcian Blue (ARAB) Staining method was used following the standard method [23].
Figure 7. Bone structure of the zebrafish 30 dpf. Alcian Blue-Alizarin Red stain. A control, B concentration of 250 µg, C 500 µg, and D 750 µg. Caudal fin vertebrae (Cfv), Caudal fin (Cf), Anal fin (Af), Dorsal fin (Df), Hemal vertebrae (Hv).

Figure 7 shows the skull part of the control and ceramic material treatment (CHA-Ag) all concentrated in blue which means cartilage, while red in the vertebrae indicates hard bone. Also, the visible parts are the caudal fin vertebrae, caudal fin, anal fin, dorsal fin, and hemal vertebrae. The staining results shown in Figure 7 identified normal bone structure and development. Generally, according to [24] many studies have focused on the components of the fish skeleton system including the skull, axial skeleton, ribs and fins, and intermuscular bones.

The results of this study provide an overview of CHA-Ag treatment in early zebrafish embryo development did not affect decreasing survival, hatching, and heart rate of zebrafish embryos. Statistical analysis showed that there was no difference between the control group and ceramic material treatment (CHA-Ag). The morphological observations showed that there were malformations and developmental disturbances in the CHA-Ag treatment with a concentration of 750 µg. At 48 hpf all embryos in the control and CHA-Ag exposure had hatched, and the heart rate at 72 hpf was above 140 beats/minute, which is an indicator of normal embryo development. The results of this study provide an overview of the use of zebrafish as animal models for testing the biocompatibility of ceramic materials (CHA-Ag) as dental implants.

4. Conclusion

Zebrafish has been developed in this study as a reliable in vivo screening model for the biocompatibility of ceramic materials. Ceramic material (CHA-Ag) had no significant effect (P<0.05) on survival rate, hatching rate, and heartbeats rate in zebrafish embryos and larvae. However, a concentration of 750 µg showed an effect on morphology and disruption in the development of embryos and larvae during 72 hours of exposure. This is characterized by changes in morphology and disruption in the development of embryos and larvae such as egg yolk deformation, spinal malformations, tail, caudal fins, body growth, and stunted eyes. Therefore, zebrafish can be used as a good animal model in testing the biocompatibility of
ceramic materials (CHA-Ag) as dental implants. Further studies on biomaterials using zebrafish embryos can be carried out dechorionated and HE & MAF staining of larvae to explore the toxicity mechanisms underlying the effects of chemical exposure. While further studies are required to corroborate these assumptions and to improve assessment of the biocompatibility of CHA-Ag. Dechorionated embryos and HE & MAF staining of larvae could be undertaken to explore the toxicity mechanisms underlying the effects of exposure to these chemicals.

Acknowledgments. This research is financially supported by Rekognisi Tugas Akhir (RTA) Program 2020 Gadjah Mada University.

References


I Komang Wisnu Budi Wijaya1, Ni Putu Juni Artini2, Ni Kadek Ayu Kristiandayanti3, L. Virginayoga Hignasari4, I Putu Oktap Indrawan5, I Gusti Ayu Agung Sinta Diarini6
{wisnu.budiwijaya240191@gmail.com1, juniartini77@yahoo.co.id2, k kristiandayanti@baliis.net3, ginahignasari@gmail.com4, oktap8indrawan@gmail.com5, gung sinta@undhirabali.ac.id6}

Jurusan Pendidikan Guru Sekolah Dasar, Universitas Hindu Negeri I Gusti Bagus Sugriwa Denpasar, Jalan Ratna, Denpasar, 80237, Indonesia1
Jurusan Pendidikan Guru Sekolah Dasar, Universitas Triatma Mulya, Jalan Danau Batur, Jembrana, 82218, Indonesia2
Bali Island School, Jalan Danau Buyan, Denpasar, 80227, Indonesia3
Jurusan Teknik Industri, Universitas Mahendradatta, Jalan Ken Arok, Denpasar, 80115, Indonesia4
Jurusan Manajemen Informatika Politeknik Ganesha Guru, Jalan Banyuasri Buleleng, 81113, Indonesia5
Jurusan Pendidikan Kesejahteraan Keluarga, Universitas Dhyana Pura, Jalan Raya Padang Luwih Badung, 80361, Indonesia6

Abstract. The Indonesian Government implements learning from home policy as a form of adaptation to learning activities in the era of Covid-19 pandemic. Even though students are learning from home, the quality of learning should be prioritized. A quality chemistry learning is a chemistry learning which develops a science process skills. This research aims to examine the strategy of science process skills development in chemistry learning of junior high school level in the era of Covid-19 pandemic. This research is categorized as a literature study by collected data from books, journals, and other resources. The analysis technique used is the content analysis technique, it is a scientific analysis technique of the content from various sources. The result of the study states that can be done by implementing computer media and carrying out learning activities in the form of practicum using equipment and materials available at home.

Keyword: chemistry learning, covid-19, science process skills, strategy

1 Introduction

Basically, natural science is the study of various phenomena in nature. Natural science is the study that has an object and using the scientific method (Samatowa, 2011). Natural science can be viewed as product, process, and attitude. As a product, natural sciences consist of some concepts, principles, theory, basis, and law. As a process, all of those natural sciences products obtained from systematically process, known as the scientific method. Meanwhile, as
an attitude, Scientists find various natural science products through the scientific method based on some attitudes such as curiosity, honesty, hard work and open (Mariana & Praginda, 2009).

Science is a branch of science that can develop skills in the 21st century (Suryandari, Sajidan, Rahardjo, Prasetyo, & Fatimah, 2018). Therefore, science learning should accommodate the essence of science, which is carried out by conceptual approach and science process skills. The conceptual approach is a way of looking at science learning which states that the process of learning emphasizes the students’ mastery of concepts. The concept is explored and discovered by the students themselves through scientific activities. Thus, the science process skill approach is the learning approach which aims to train students related to the skills used in the scientific method, such as observation, hypothesizing, designing experiments and other skills. Students’ science process skills is important aspects that must be possessed in learning science (Tanti, Kurniawan, Kuswanto, Utami, & Wardhana, 2020). Science learning with science process skills makes them able to describe concepts, make predictions, raise questions, examine predictions and interpret data (Ratnasari, Sukarmin, Suparmi, & Harjunowibowo, 2018). Other than that, Scientific process skills are one of the most important basic science skills of the 21st century (Gunawan, Harjono, Hermansyah, & Herayanti, 2019).

Chemistry is a part of the sciences. Therefore, it has the same characteristics as the sciences (Redhana & Suardana, 2021). Chemistry is a study of matter, properties, and changes of matter including the energy involve in the changing. The study of chemistry consists of 3 (three) things, namely macroscopic, microscopic, and symbolic. Macroscopic is the study of chemistry which could be observed by the naked eye in daily life. Microscopic is the study of particles composing matter (Johnstone, 1993). On the other hand, symbolism is the study of symbols that represents the chemical phenomena or well known as “chemical language” (Artini & Wijaya, 2020). These three aspects are closely related to one another.

In Indonesia, chemistry learning is given at junior high school and senior high school level (Wijaya, Suastra, & Muderawan, 2014). At the junior high school level, chemistry learning is carried out in an integrated manner on science subjects, meanwhile at the senior high school level chemistry learning is carried out in a separate system. The objective of learning chemistry is that the human resources in Indonesia has a good understanding of chemical concepts and the ability to apply the concepts in daily life. Chemistry learning is important for the students. It is one of the prior step for the students to identify and understand the concepts of nature to build the proficiency and thinking ability in order to play an active role in applying their knowledge in the world of technology. (Ulianta, Sukardjo, & Priono, 2020).

As part of science, chemistry learning should be carried out by science process skills approach. Science process skills is a thinking skill, reasoning skill and act logically to research and build a basic science concept that can be able to solve science problems (Retno & Yuhanna, 2019). Science process skills are very important to be instilled to the science students because it is very useful in solving daily life problems related to science. In addition, learning with science process skills approach makes the process of science learning more interesting because students are actively involved in the learning process.

The Covid-19 pandemic has changed the learning system in Indonesia including chemistry learning at the junior high school level. Indonesia government through the Ministry of Education and Culture gives instruction that learning is carried out with the concept of “Learn From Home”. This is the learning concept which is carried out by teachers and students at home by minimizing face to face activities and utilizing online learning facility. Learning with
the concept of “learn from home” become the most effective mitigation step for minimizing the deployment of Covid-19 epidemic to the students (Herliandry, Nurhasanah, Suban, & Kuswanto, 2020). Even though the learning system has changed, the quality of chemistry learning at the junior high school level should be maintained. One of the quality chemistry learning indicators is the learning that instills science process skills to students. Moreover, chemistry topics at the junior high school level are very close to daily life, so that is still possible to instill the science process skills in the learning process. This can be done by carrying out computer-based learning and doing chemistry practicum by utilizing equipment and materials available at students’ homes. In this paper, it will be explained how the strategy of science process skills development in chemistry learning in the era of Covid-19 pandemic.

2 Method

This research is categorized as a literature study. A literature study is a type of research by collecting data and information deeply related to the research object as the main characteristic. This research was conducted by examining various resources such as books, journals, and other resources related to science process skills, chemistry learning, and learning in the era of Covid 19 pandemic. The data analysis technique uses content analysis technique which are a scientific analysis of a data message or literature.

3 Results and Discussion

3.1 Science Process Skills

Science process skills is a form of science as a process (Verawati & Prayogi, 2016). Science process skills are also, skills used by the scientists to investigates natural phenomena where these skills can be trained to the students according to their stage of development (Risamasu, 2016). Science process skills should be instilled in all science students and their branches of science, namely chemistry, physic, and biology. There are some reasons why science process skills are very important to instill, namely as follows:

1. Now days, The science development is taking place so fast, so it’s not possible for the teachers to teach all of the science products to the students.
2. Generally, students will be easy to understand the complex science concepts if accompanied with concrete examples and finding the concept through experimental activities.
3. Basically, all science products are tentative which still can be questioned, corrected or even denied.
4. The science learning process must pay attention to the development of students’ attitudes and values (Semiawan, 1992).

Science process skills consist of several types. Each science process skill has its own indicator. The type of science process skills and the indicators can be seen in Table 1.

<table>
<thead>
<tr>
<th>No</th>
<th>Science Process Skills</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Observing</td>
<td>Use senses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Collect facts</td>
</tr>
<tr>
<td>Process</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td></td>
</tr>
</tbody>
</table>
| 2 Interpreting | Look for similarities and differences  
Classify  
Record the observation result  
Connect the observation result  
Find a pattern  
Draw a conclusion |
| 3 Predicting | Explain the possibilities of what might happen  
Set a hypothesis |
| 4 Using equipment and materials | Skilled in using materials/equipment  
Apply concepts in the new situation  
Explain what happen |
| 5 Applying concepts | Determine the materials, equipment, and sources used.  
Determine the variables.  
Determine the dependent and independent variables.  
Determine what will be observed  
Determine how to process the observation result. |
| 6 Designing an experiment | Determine how to process the observation result.  
Determine the procedure  
Determine the dependent and independent variables.  
Determine what will be observed  
Determine the variables.  
Determine the materials, equipment, and sources used. |
| 7 Communicating | Arrange and communicate the report  
Discuss the result of experiment  
Describe data in form of graph, table and etc.  
Read the graph and table. |
| 8 Asking | Ask what, how and why  
Ask to get an explanation  
Ask a hypothetical question |

(Source: Suastra, 2008)

On the Table 1 showed that each aspect of science process skills has clear and measurable indicator. Science process skills can be learned by students a simple form based on the development stages of students in junior high school level. Science process skills can be developed if students are active in the learning process. Students are situated to read individually, relate the new concepts by discussion and using new terms, concepts and principles through a set of learning activity (A’yun & Subali, 2018).

There are five aspects that need to be considered in helping students develop the science process skills, namely providing opportunities to: (1) use science process skills to explore the material and phenomena closely, (2) Discuss in small group and classroom discussion, (3) listen to their words and study the result to know their way of thinking, (4) encourage critically review of how the activity is completed, (5) introduce techniques that require further skills. By developing science process skills, students will be able to discover and develop their own facts and concepts as well as growing and developing the required value attitudes. Thus, these skills become a driving force for the discovery and development of facts and concepts as well as the growth and development of attitudes and values.

### 3.2 Chemistry in Junior High School Level

Chemistry has become part of the subjects taught at the junior high school level since the implementation of the Education Unit Level Curriculum (KTSP). This subject is taught in an
integrated manner on a science subjects. There are several things that encourage chemistry at junior high school level to be integrated with the science subject, such as (1) In some country, chemical study materials have been given in junior high school and even in elementary school level such as in England, Philippine, Singapore, and Australia, (2) Demands of the international world (through International Science Olympiad) where the problems issued are also include chemistry, (3) Based on the students’ needs. On this basis, the government took a positive step by incorporating chemistry subject into science subject (Salirawati, 2008).

In the 2013 curriculum that applies in Indonesia, chemistry still become part of the science subject at the junior high school level. The scope of chemistry topics for junior high school students are shown in Table 2.

Table 2. The Scope of Chemistry Topic in Junior High School Level

<table>
<thead>
<tr>
<th>No</th>
<th>Basic Competences</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Explaining the concept of mixture and single substance (element and compound), physical and chemical properties, physical and chemical changes in daily life (knowledge).</td>
<td>Element, compound and mixture</td>
</tr>
<tr>
<td></td>
<td>Presenting the result of investigation or work about the properties of solution, physical and chemical changes or separation of a mixture</td>
<td>Mixture separation</td>
</tr>
<tr>
<td></td>
<td>(Skill)</td>
<td>Physical and chemical properties</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physical and chemical changes</td>
</tr>
<tr>
<td>2</td>
<td>Explaining various additives in food and beverage, addictive substances, as well as their impact on health (Knowledge)</td>
<td>Acid, base and salt</td>
</tr>
<tr>
<td></td>
<td>Writing a scientific paper about the impact of additives and addictive abuse for health (Skill)</td>
<td>Additives on food and beverages</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Narcotics, psychotropics, and other addictive substances</td>
</tr>
<tr>
<td>3</td>
<td>Connecting the concept of particle matter (atom, ion, molecule), the structure of simple substance with the properties of materials used in daily life, as well as the impact of their use on human health. (Knowledge)</td>
<td>Atom, Ion, and molecule</td>
</tr>
<tr>
<td></td>
<td>Presenting the result of investigation about the properties and utilization of materials in daily life (Skill)</td>
<td></td>
</tr>
</tbody>
</table>

Chemistry learning in the junior high school level has the following characteristics: 1) adjusted to the cognitive, affective, and psychomotor development of junior high school students; 2) carried out by scientific approach; 3) the topics presented are related to the chemical concepts in daily life; 4) concerning macroscopic, microscopic, and symbolic aspects and 5) emphasizing the concept mastery and science process skills development. In the learning process, students are expected to be the main actors or it’s known as students’ centered learning. The teachers act as a facilitator when students experience difficulties or find obstacles in chemistry learning.
3.3 Science Process Skills Development

Chemistry learning in the junior high school level should have considered the development of science process skills to the students, although currently in the Covid-19 pandemic situation. This can be done in two ways, namely carrying out learning by using computer-based learning media and carrying out chemistry practicum by using materials and equipment available at home. The explanation of each follows:

3.3.1 Computer-Based Chemistry Learning

Computer-based chemistry learning is the learning of chemistry using computers as learning media or source of learning. Technological development, especially computers that are growing rapidly has given an influence on the implementation of chemistry learning (Sulistiyarini & Sabirin, 2020). Technology leads the learning instruction not always conducted by face-to-face learning but also through the online learning (Fitriyana dkk, 2020). One of them is the advance of computer-based information technology provides an opportunity in creating learning materials to support learning using the inquiry approach. This technological advancement makes it easy in designing learning media to bring real phenomena, in the form of laboratory facts video and daily life into inquiry class. There are several advantages using computer-based media in chemistry learning, such as (1) the experiment can be faster; (2) the experiment design can be more complex; and (3) more focus on the theory aspect (Wijaya, Kima, & Suardana, 2012).

The learning forms of computer-based learning media such as 1) drill and practice, 2) tutorial, 3) games, and 4) simulation. The drill and practice is generally used for exam/test preparation and presenting problems practice. The tutorial contains instructions for solving problems or on how to design an experiment. The simulation contains practicums that are done virtually where students can do manipulation of some variables or it also can be referred to as virtual laboratories. The instructional games generally used for creating a fun learning ambiance (Amanah, 2016).

The chemistry learning forms that are able to develop science process skills, namely by tutorial and simulation. If the teacher wants a tutorial form, so that the teacher must inform first the learning objectives and learning topics and continued by sharing a video or a video link about tutorials of doing experiments. Currently, many are available on the internet related to a video guidelines of chemistry practicum in junior high school students level. On of them is uploaded on Youtube at the following link https://www.youtube.com/watch?v=ZOiZGCun4, is shown in Figure 1.
In this tutorial is presented about how to do the physical and chemical changes practicum. The video is explained about materials and equipment that should be prepared and the practicum procedure. This can help students in developing two aspects of the science process skills, namely observation ability and experimental design ability.

The second form is practicum simulation-based learning or known as virtual laboratories. Virtual laboratory media is one type of digital media (Saputro & Setyawan, 2020). At the moment, computer technology has been able to provide some virtual laboratory facilities for chemistry learning in junior high school. These facilities are also available directly on the internet or can be designed individually by using various software. In implementing the virtual laboratories to the learning activities, the teacher must explain first how to use it. The examples of virtual laboratories about acid and base practicum which is developed by using Adobe Flash CS 3 software are shown in Figure 2, 3, and 4.
This form of practicum simulation help students to develop various science process skill, namely observing, designing an experiment, interpreting and using materials and equipment. Looking at the advantages that are presented, the computer technology is worth to apply in
chemistry learning activities especially in junior high school. The reasons underlying the needs of integrating computer technology into learning activities, especially chemistry learning are: (1) with the presence of computer technology in learning activities, there will be a shift in the learning paradigm from teacher-centered to student-centered, (2) Integrated learning model with computer technology is active and collaborative learning model, and (3) computer technology can improve motivation, skill, and thinking structure (Sutrisno, 2011).

3.3.2 Chemistry Practicum at Home

Chemistry is not a study of being in a laboratory only, but it is a study that can be everywhere, including at home. Therefore, chemistry practicum also can be done at home by utilizing equipment and materials at home. In implementing chemistry practicum at home, the steps that should be done by the teacher to the student are informing the learning objectives and a summary of the topics verbally or written, giving a practicum guidelines and tasks to students to make a practicum report. The examples of chemistry practicum activities that can be done at home are as follows:

<table>
<thead>
<tr>
<th>No</th>
<th>Topics</th>
<th>Practicum Objectives</th>
<th>Method</th>
<th>Science Process Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Acid and Base</td>
<td>Making a natural acid base indicator from turmeric.</td>
<td>Equipment: grater, bowl, sieve, mortar and three small cups. Materials: sufficiently turmeric, warm water, lime, table salt, antacid tablet. Procedure: Peel the turmeric until all clean, grate the turmeric and when it is all grated add some warm water, strain the mixture with the sieve and the filtrate is placed in the bowl, Squeeze the lime and place it in a small glass, dissolve table salt in the other small glass which has water in it, mash the antacid tablet until it smooth and put it into the other small glass which has water in it, stir it for a couple of times. Add each one tea spoon of turmeric solution into the</td>
<td>Observing, using equipment and materials, designing an experiment, interpreting and communicating</td>
</tr>
</tbody>
</table>
lime juice, table salt solution and antacid table solution. Observe the color changing.

<table>
<thead>
<tr>
<th>2</th>
<th>Physical and chemical changes</th>
<th>Investigating the corrosion process in the iron</th>
<th>Observing, using equipment and materials, designing an experiment, interpreting and communicating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Equipment: small glass, two small iron nails</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Materials: bleach solution for clothes and vinegar</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Procedure: Pour each out 5 spoons of bleach solution and vinegar into a small glass, put a nail into it. Leave it for three minutes and observe what happen to the nail and compare with the nail which is not soaked in the water.</td>
<td></td>
</tr>
</tbody>
</table>

Based on the data presented in Table 3, it can be seen that various science process skill can be developed through chemistry practicum at home. Therefore, this activity can be a recommendation for the chemistry learning in junior high school level during the Covid-19 pandemic. The parents are expected to give support and supervision to the children when they are doing a chemistry practicum at home.

In developing science process skills for chemistry learning in junior high school, the roles of the teacher can not be ignored. The roles of the teacher are as a motivator, a learning planner, a facilitator, and an evaluator (Wijaya, 2019). As a motivator, the teacher should be able to motivate their students to study diligently especially chemistry subject during this Covid-19 pandemic. As a learning planner, the chemistry teacher (science) in junior high school level is expected to be able to design a computer-based chemistry learning properly or chemistry practicum at home, so that the students are able to develop the aspects of the science process skills. The role of the teacher as a facilitator is to help students when they have difficulties in developing science process skill through computer-based learning or practicum at home. Then, the role of the teacher as an evaluator is that the teacher is expected to be able to develop an evaluation system to measure the science process skills that their students have achieved.

4 Conclusion

The chemistry topics for junior high school students are really close to daily life. Therefore, it is appropriate for chemistry learning is carried out by developing science process skills. The development of science process skills must be carried out in chemistry learning for junior high school although there is a Covid-19 pandemic at the moment. This is can be done by doing computer-based chemistry learning with tutorial pattern and virtual laboratory simulations as well as inviting students to do chemistry practicum using equipment and materials available at home. Various science process skills can be developed through some activities such as observing, using equipment and materials, designing an experiment,
interpreting, and the other science process skills. In developing the science process skills, the roles of the teacher are as a motivator, a learning planner, a facilitator, and an evaluator. This result of the study also gives meaning that science learning especially chemistry in the junior high school level is not only done at school and laboratory but also can be done at home. Apart from that, the result of this study also gives contribution in the chemistry education field particularly science process skills outside laboratory.

References


Digital Marketing Chatbot Using API Dialog Flow
Case Studi ITB Stikom Bali, Jimbaran Campus

I Putu Gede Abdi Sudiatmika¹, Made Suci Ariantini²
{gede_abdi@stikom-bali.ac.id¹, suci.ariantini@stiki-indonesia.ac.id²}
ITB Stikom Bali, Computer System¹, STMIK Stikom Indonesia²

Abstract. The presence of technology in everyday life makes all activities fast and easy. Technology is also present and reaches all levels of society. Communities are competing to create innovations so that all community activities become more effective and efficient. The ITB Stikom Bali Campus, especially the Jimbaran Campus, in attracting prospective students in marketing by providing information to prospective students is often done manually. The same thing is repeatedly conveyed to prospective students who get information at school and those who come to campus. If the number of students is large, it will take a very long time, and some prospective students do not get information about the ITB Bali Stikom Campus. The Industrial Revolution 4.0 demands a digital marketing concept that can be combined with the capabilities of Machine Learning - Natural Language Processing (NLP), which is the study of how computers or systems can communicate with human language and can answer questions. The concept of NLP is used to create automatic answering services or chatbots. This study aims to build a chatbot system that can provide information to students about the STikom Bali ITB Campus. The chatbot that is built will use Dialogflow, a framework from Google. The method used in this research is the waterfall method. The results of the data analysis of the collection of questions from existing student candidates are compiled and the possible answers will be given by the chatbot. The results of this study indicate that the chatbot has been implemented well, it can be seen from the chatbot that has answered questions from users well according to the given keywords. Questions that can be answered include Cost Information, Study Program Information, Study Program Profile Information, and the registration process at the ITB STikom Bali Jimbaran Campus.

Keywords: chatbot, Dialogflow, Stikom_Bali, API

1. Introduction

The presence of technology in the 4.0 industrial revolution in everyday life makes all activities fast and easy. Technology has also been present and reaches all levels of society[1]. People are competing to create innovations so that all community activities become more effective and efficient. Almost every community activity, such as in offices, companies, schools, homes, and anywhere else, always uses information technology, whether using computers, laptops or only through smartphones.[2] By utilizing this information technology, people can experience various conveniences such as the ease of storing data, organizing, and retrieving data. With the support of software that is always evolving, combined with the right hardware configuration, a more reliable information system will be created.[3]
The ITB STIKOM Bali Jimbaran Campus is one of the campuses that annually recruits prospective students. Student recruitment is carried out by visiting schools and conducting socialization with each student. Students who want to know about the STikom ITB Bali will communicate by telephone or come to the ITB Stikom Bali Campus. The marketing team will serve students who come or call one by one with relatively repetitive information. The marketing team's limitations resulted in fatigue in receiving calls and serving prospective students and even missing information about ITB Stikom Bali. The development of the Industrial Revolution 4.0 allows the concept of digital marketing to be combined with the capabilities of Machine Learning - Natural Language Processing (NLP)[4], which is the study of how computers or systems can communicate with human language and can answer questions. The concept of NLP is used to create automatic answering services or chatbots[5]. Chatbot system selection, because chatbot has criteria to convey information automatically and in real-time. One of the chatbot frameworks that is widely developed is Dialogflow by Google.[6] This study aims to build a chatbot using a dialog flow app to respond to questions regarding student registration information at the ITB Stikom Bali Jimbaran Campus. To develop a software use a waterfall software lifecycle [3], [7], [8].

2. Method

The method used in this application is the waterfall method. The waterfall model is the most frequently used software development model. The waterfall model to develop a software must finish step by step in stage. If has problem must back to previous stage. The next stage will not be carried out before the previous stage has been completed, and one cannot return or repeat the previous stage.

The Waterfall Model is sometimes called the classic life cycle, which implies a systematic and sequential approach to software development, starting with the specification of user needs and continuing through the planning stages. Modeling, constructing, and delivering systems/software to customers/users (deployment), which ends with ongoing support for complete software.

![Figure 1. Waterfall method](image-url)
The chatbot design is carried out, which will be built from the needs analysis in the previous stage. At this stage, an overview of the data flow from the system will be given using a flowchart. The flowchart will contain a clear description of the system to continue to the implementation stage. Stage of implementing the design that has been made into a programming language that is understood by the computer through the coding process. Implementation is carried out following the system design stages that have been designed in the previous stages. At this stage, unit units that have been compiled and tested are also carried out. All units that have undergone testing that has become systems are merged. It is done to determine whether the chatbot system results are following the design and user requests for the needs analysis. This stage also provides several possible tests to determine whether there are still errors in the compiled chatbot.

Maintenance is also carried out at this stage, and maintenance includes correcting errors that were not found in the previous step so that later the system created can meet the objectives to be achieved. There is no shortage of data required. System Design is a process that focuses on the design of a system, including data structures, software architecture, interface representations, and coding procedures. This stage translates the system requirements from the requirements analysis stage into a design representation to be implemented into a program at a later stage. At this stage, all units that have undergone testing that has become systems are merged. It is done to determine whether the chatbot system results are following the design and user requests for the needs analysis. This stage also provides several possible tests to determine whether there are still errors in the compiled chatbot.

2.1 **Chatbot**

A chatbot is a computer program that is programmed to be able to interact between humans and computers using everyday language. Concrete examples like the Help Bot on Yahoo! Messenger and ALICE (Artificial Linguistic Internet Computer Entity) developed by Dr. Richard S. Wallace. A chatbot is a QA system or question answering system, which gives a computer the ability to interpret the natural language to have a conversation with a human or a user; a conversation that occurs is like two humans having a dialogue. Dialog Flow will match the words from the user's request then processed by the "Agent" Machine Learning then provide feedback to the user-user with the Response and output data in JSON format.[9]

2.2 **Dialog Flow API**

Dialog Flow API is a Google technology that can interact with humans with computers based on voice and text conversations supported by artificial intelligence (Artificial Intelligence). Dialog Flow API is Google's proprietary technology for developing interactions between humans or users and computers using human language or in everyday language. The Dialog Flow API provides a platform that can allow developers to design and implement a conversation interface that can be embedded with external applications such as bots [10]

2.3 **Natural Language Processing (NLP)**

Natural Language Processing (NLP) is a form of representation of a message that is communicated between humans or users. One form of representation is in the form of a voice or spoken language, but it is often applied in the form of text or writing in questions from users. In language can be distinguished, namely natural language and artificial language. Natural languages are often used in everyday life, and artificial languages are languages specially made to meet specific needs, such as programming languages.[11]
3. Results and Discussion

3.1 Some of the Dialog Flow Features

The following is a picture of the workflow on the Dialog Flow API chatbot ITB Stikom Bali.

![Figure 2. Dialog Flow Process (Chandra, 2020)](image)

1. Agent, It is an NLU (Natural Language Understanding) module used for flow conversation management. Stages to create an agent are to go to the site http://dialogflow.com; on the dashboard, go to the console (Go to Console). After that, log in using a Google account, then the site will redirect a page to create a bot, which will then be directed to the console page where the bot is configured [12].

2. Intent, Intents is a conversation mapping between the user-user and the action given by the bot. Example
   
   User: Hai
   Bot: Haloo Welcome
   Sentence Users added to the menu Training phrase and to respond bot put in Response
   
   In the Intent we can also include Contexts are used to determine the flow of the conversation and the parsing of the parameters of the previous conversation Intent On chatbot Digital marketing Itb Stikom Bali is as follows table 1:

<table>
<thead>
<tr>
<th>Intent 1</th>
<th>Intent 2</th>
<th>Intent 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greeting Massage</td>
<td>Get_Name</td>
<td>Get_School</td>
</tr>
<tr>
<td>Default Fallback</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study Program</td>
<td>Get_prodi</td>
<td>Get_Telpn</td>
</tr>
<tr>
<td>Register</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study Profile</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.2 Entities

The entity is a feature used to retrieve parameter values from queries sent by the user [13]. Entities are divided into three: System Entities are entities created directly by Dialog Flow such as @sys. time, @sys. date, @sys. Email, @sys. Phone-number, and others. Programmers themselves create developer Entities, and the three User Entities are created based on the user's session id, such as items that users have purchased or playlists from users. In designing this chatbot, researchers added some entities to meet the extra value parameter, including @prodi, @nama, @telpn, @sekolah, @prodi_profil, @Costs, @Register. Conversational flow presence aims to be a conversation between the chatbot, and customers has a flow and standard rules. The customer will ask about something, but before the customer's wish is fulfilled, steps must be followed. The following is a workflow image from the conversation flow for a chatbot at ITB Stikom Bali.

![Conversation Flow](image)

The chatbot system has two different responses related to user experience input, including: Default Fallback, which is the chatbot response to user questions about the problem topic. Non-Default Fallback, namely chatbot responses related to user questions outside the topic of the problem.

3.3 System Implementation

System starting with the home screen from the home screen application, there are two menu developer information and starting a conversation seen in figure 4. The intent is the greeting the bot gives the first time the user-user starts a conversation. The bot will respond accordingly. For example: 'Hi' or 'hello.' As shown in the following figure 5. The intent is a process where the user-user provides a response that is not contained in the intent, then the 'bot' will respond in the
form of an error message to the user. For example: 'h,' 'our,' or 'ok' as shown in the following figure 6. A process where the user will be given a response in the form of a list of study programs in ITB Stikom Bali shown in figure 7. In figure 8, the User is given a response regarding the graduate study program and an explanation of the Study Program in the STIKOM. Figures 9 and 10 explain the chatbot responses regarding registration and costs for each study program; after the user is successful in registering, Marketing ITB Stikom, Bali will schedule the test.
Figure 7. Intent Prodi

Figure 8. Intent Profile Of Prodi

Figure 9. Register Intent

Figure 10. Price Of Study
4. Conclusion

From the implementation, it can be concluded that the chatbot that is built can answer questions given by the User in real-time. The chatbot can also provide a response when the user enters a word that does not match the one in the intent. The chatbot will give an optimal response if the User provides keywords following those created in the intent. This chatbot only handles questions about study programs and registration at the ITB Stikom Bali Jimbaran Campus. The Recommendation for the future is to develop the chatbot and add features to the chatbot. In the future, it is recommended that chatbots be able to recognize regional languages so that they can communicate like friends.

Acknowledgement. Our thanks for the Research and Publishing Center of ITB Stikom Bali which has provided support and funded the publication of this research.

References

10.1109/Icoris.2019.8874907.
The Effectiveness of Authentic Project-Based Assessment on the Online Learning System Toward Learning Result of Student Viewed from Critical Thinking Ability

Komang Hari Santhi Dewi¹, I Nyoman Bagus Pramartha²
{santhi.dewi@stikom-bali.ac.id¹, bagus.pramartha@stikom-bali.ac.id²}

Computer System Study Program, Faculty of Informatics and Computer, Institut Teknologi dan Bisnis STIKOM Bali. Denpasar, Indonesia

Abstract. This study aims to recognize the effectiveness of authentic project-based assessment on the online learning system toward learning result of scientific writing methodology viewed from critical thinking ability. This research method was a quasi-experimental design with the posttest only control group design. The subjects of this study were students of STIKOM Bali academic year 2019/2020, and the sample was 80 students, which was divided into four classes. The research instrument consisted of a test of learning outcomes in scientific writing methodology courses and tests of critical thinking ability. The obtained data were calculated by using a one-way analysis of covariance (ANCOVA). The results showed that the learning outcomes of students who applied authentic project-based assessments were higher than students who applied conventional assessments. The ability to think critically gives a positive contribution of 62% to student learning outcomes using authentic project-based assessments and a contribution of 48.1% to student learning outcomes using conventional assessment.

Keywords: authentic assessment, critical thinking, learning result, project

1 Introduction

The learning and assessment process are two crucial components in determining an educational program's success and quality. The learning process's effectiveness can be influenced by many factors, namely the selection of learning techniques or strategies, types of assessment, and application of learning technology. "The results of Cambridge International research through Global Education Census 2018 show that Indonesian students are very familiar with technology, not only social media but also for learning needs. The results of the study show that Indonesian students in computer space are the highest worldwide (40%). In desktop computer use, they are also the second-highest in the world (54%), after the United States [1]. Referring to this, many universities, including Indonesia, have long carried out online lectures as an implementation of digital-based learning. At ITB STIKOM Bali, online-based learning is combined with face-to-face meetings through e-learning services (virtual classes), scheduled according to the academic calendar. Lecturers in the ITB STIOM Bali environment have used e-learning to upload lecture material documents, assignments, quizzes, exams, and discussion forums. However, the use of media and online-based learning strategies is not always followed..."
by the use of effective tests in assessing student learning outcomes. So far, the use of assessment still uses conventional assessment, namely assessment using written tests (theory courses) and practicum results (lab/practicum subjects) at the end of the semester, so that in this way it is not optimal in revealing the quality of student learning outcomes from the aspects of attitudes and performance. Since the spread of the Coronavirus (COVID-19) pandemic in Indonesia in early March 2020, the ministry of education and culture has demanded that all levels of education carry out this online-based learning in full, which means that lecturers and students carry out lectures only through online media, both assignments and test execution. Thus, lecturers need to pay attention to the application of assessment in the online learning process to maximize student learning outcomes. Assessment is a systematic and systemic effort by collecting valid and reliable data or information to be processed as a basis for consideration in making decisions on an educational program. Given the importance of this assessment in determining learning success, authentic assessment can be used as an alternative in assessing learning outcomes in online learning systems. This is supported by research from Wijayanti (2014), which shows that authentic project-based assessment with a developed scientific approach can effectively improve scientific thinking skills. Overall, the increase in scientific thinking skills is 0.86, which means the increase is with high criteria” [2]. The implementation of authentic assessment by project-based learning will enhance the problem solving skill of the student and high category concept mastery [3]. In learning through projects students conduct various activities to solve real-world problems and are responsible for making decisions based on the knowledge of various activities in the project [4]. To optimize the measurement of the quality of learning outcomes, it is necessary to pay attention to various aspects such as student skill profiles and subjects. In this study, the subject used as the object of research is the Scientific Writing Methodology course. By paying attention to learning strategies, teaching materials, and student conditions, the assessment used in this study is a project assessment. This project appraisal is useful for assessing general investigative skills, understanding, and student knowledge through critical thinking skills. Critical thinking ability are higher-order thinking skills that include behavioral tendencies and cognitive skills to solve problems, draw conclusions, calculate possibilities, and make decisions. The indicators of achieving the quality of student learning outcomes in the Scientific Writing Methodology course can be seen in the accumulated scores of assignments, quizzes, midterm exams, and final semester exams. Based on the analysis of the situation, research was carried out related to the effectiveness of authentic project-based assessment on the online learning system toward learning result of student viewed from critical thinking ability.

2 Literature Review

In essence, authentic assessment emphasizes holistic assessment to seek and explore information about the competence of students authentic in using their knowledge, attitudes, and skills in carrying out lecture assignments. Authentic assessment can also monitor prospective teachers’ learning progress and motivate and provide opportunities for students to improve their work [5]. Assessment is a systematic and systemic effort that collects valid and reliable data or information to be processed as a basis for consideration in making decisions on an educational program [6]. The primary purpose of conducting an assessment or evaluation in the learning process is to obtain accurate information about the learning process level. Based on this information, a follow-up can be done, which is an evaluation function, in the form of proper
placement, providing feedback, diagnosis of learning difficulties, and determining the increase in the level or graduation of education at certain levels of education.

Authentic assessment has relevance to scientific activities and approaches because this type of assessment can describe the improvement of student learning outcomes in a comprehensive manner in assessing input, process, and learning outcomes which consist of student knowledge, skills, and attitudes [7]. One type of authentic assessment that can be used to integrate students' analytical skills is an authentic project-based assessment. Expert opinion on project-based learning shows that the use of this learning model strongly supports the development of scientific capabilities [8]. A project-based assessment is a comprehensive assessment of the student's ability through assignments that contain investigations and must be completed within a certain time. This project assessment is useful for assessing general investigative skills, understanding and authentic assessment of process and product knowledge can be measured both relevant tasks and contextually measuring students' knowledge and skills” [2]. The application of authentic assessment can provide several benefits, such as identifying direct measurement of expected competency indicators of student performance; encourage students to demonstrate their performance in real and meaningful situations; allow students to build on their learning outcomes by selecting and structuring answers based on their knowledge and situational analysis so that the answers are relevant and meaningful; and integrating teaching, learning and assessment activities [9]. Project assessment-based learning can be combined with online-based e-learning so that students can complete projects with electronic media. The learning process with e-learning is beneficial for students to interact with lecturers and between students and can be done at any time, without being limited by time or place. E-learning is technology development in learning, namely by utilizing computers and other information devices such as multimedia and the internet [10]. In reality, there are still lecturers who judge students only from one aspect, namely cognitive aspects, for example, from written tests on final exams (semester exams). This assessment means only providing a momentary picture of student performance. The use of midtest and semester exams as benchmarks for student success only reflects the cognitive aspects' ability, while the affective and psychomotor aspects are not given attention. "Conventional assessment using tests is often outside the real-world context of students. The conventional assessment also does not fully describe student learning progress as a whole because the results given from this conventional assessment tend to be abstract numbers or letters" [11]. The differences between project-based assessment and conventional assessment are summarized in the following table:

| Table 1. Comparison of Project-based Assessment and Conventional [12][13] |
|-------------------------------------------------|-------------------------------------------------|
| Project-based Assessment                         | Conventional Assessment                         |
| Concerned with the ability of students to apply their knowledge into observable performance or products | Prioritizes students' conceptual understanding |
| Time-consuming to create and implement but results in an assessment format that can be used over and over again with the same student or new students | It takes a lot of time for the implementation to be faster and can be used for many students simultaneously, but it is used only once for a group of students. |
| Allows to diagnose and remediate learner performance and map student progress over time | It is possible to diagnose and remediate student performance but only for open-ended questions. |
| Focusing learning on student performance and developing students' thinking skills. | Focusing learning on the subject matter |
In maximizing learning outcomes with project-based assessments, an essential aspect to consider is students’ thinking ability. High-level thinking ability can be developed in the learning process, especially in learning mathematics, one of which is critical thinking. In the sense of learning, critical thinking is a thinking ability that students must build and master. Critical thinking is rational and reasonable thinking that is focused on making decisions about what to believe. Critical thinking ability are higher-order thinking skills that include behavioral tendencies and cognitive skills to solve problems, draw conclusions, calculate possibilities, and make s about what to believe or do. Most students can master learning material based on the concepts being taught. However, in some applicative problems, students sometimes erroneously answer and determine solutions to these problems. Students who think critically will be able to answer problems well. Besides, students who think critically can also use abstract ideas to be able to model problem-solving effectively. Assessment instruments that are well designed and following the level of thinking ability can improve students' thinking power, especially critical thinking [9]. Based on this definition, critical thinking is focused on higher-order thinking skills that include behavioral tendencies and cognitive skills to solve problem thinking ability recalculate possibilities, and make decisions about what to believe or do.

3 Method

This research method is a quasi-experimental design with posttest only control group design. The independent variable in this study is learning assessment which is divided into project-based authentic assessment and conventional assessment. The dependent variable in this study is the student learning outcomes in the scientific writing methodology subject, while the critical thinking ability is used as a controlling variable (covariable). Critical thinking skills data in the two research groups will be collected using the test method of critical thinking skills. Simultaneously, the measurement of learning outcomes is obtained after the completion of treatment in both the experimental class and the control class by using the learning outcome test method through project appraisal. This research uses a random sampling technique (random class). Two classes as the experimental group and the other two classes as the control group. In the experimental group, learning was applied by applying project assessment, and in the control group, group learning was applied by applying conventional assessment. The experimental group numbered 40 people, and the control class also numbered 40 people. Thus the total sample of the study was 80 students. This research uses descriptive quantitative analysis techniques. Before testing the hypothesis, a prerequisite test is carried out including data normality test, variant homogeneity test, linearity test and the testing of the regression line. The research hypothesis was tested using covariance analysis assisted by the SPSS 20.00 program at a significance level of 0.05.

4 Result and Discussion

Therefore, the data in this study were grouped into four groups of data due to the treatment of the application of project-based authentic assessment and conventional assessment in terms of critical thinking skills. The data groups are; (1) data on student learning outcomes that apply authentic project-based assessments; (2) data on student learning outcomes that apply
conventional assessment; (3) data on critical thinking skills of students who apply authentic project-based assessment, and (4) data on critical thinking skills of students who apply conventional assessment. Each group consisted of 40 subjects as the unit of analysis. Data descriptions relating to measures of central tendency such as calculated means, mode, median, and size of the spread of data (standard deviation) for all data groups are shown in the following table:

**Table 2** The Results Of Descriptive Analysis Of Student Learning Outcomes And Critical Thinking Ability In Student Groups Who Apply Project-Based Authentic Assessment and Conventional Assessment

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Project-Based Authentic Assessment</th>
<th>Conventional Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Critical Thinking</td>
<td>Student Learning Outcomes</td>
</tr>
<tr>
<td>Total Number of Data</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Mean</td>
<td>129.50</td>
<td>87.85</td>
</tr>
<tr>
<td>Median</td>
<td>128.50</td>
<td>89.00</td>
</tr>
<tr>
<td>Mode</td>
<td>125.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>13.77</td>
<td>10.17</td>
</tr>
<tr>
<td>Range</td>
<td>50.00</td>
<td>38.00</td>
</tr>
<tr>
<td>Minimum score</td>
<td>101.00</td>
<td>62.00</td>
</tr>
<tr>
<td>Maximum score</td>
<td>151.00</td>
<td>100</td>
</tr>
</tbody>
</table>

Based on the results of the descriptive analysis showed that the average score of student learning outcomes who implemented the Project-Based Authentic Assessment was higher than that of students who implemented the Conventional Assessment. When viewed from Critical Thinking, students who implement Project-Based Authentic Assessment are also higher than students who implement Conventional Assessment.

The results of the prerequisite analysis showed that the test data distribution normality results show that the probability value in **Kolmogorov-Smirnov** in the four groups is greater than the probability value of 0.05. Thus the data distribution of learning outcomes and students' critical thinking ability in the group implementing authentic project-based assessment is normally distributed. The homogeneity test of variance was carried out using the application SPSS 20.0 observing the statistical value Lavene. The results of the homogeneity test of data variance on critical thinking ability and student learning outcomes in the group of students who implement authentic project-based assessments and conventional assessment shows that the data has a homogeneous variance with a value probability> 0.05. A linearity test is conducted to determine the relationship between controlling variables, and the dependent variable is linear or not. The linear equation for students implementing authentic project-based assessments (A₁) is **Y=24,814 + 0.482X**. While the linear equation for students implementing conventional assessment (A₂) is **Y = 17,274 + 0.657X**. The linearity test using the F test shows that the two data groups are linear and have directional coefficients.

The first hypothesis testing is to determine "the difference in the quality of learning outcomes between students who apply authentic project-based assessments and students who learn with a conventional assessment on online learning systems." The test was carried out using one-way ANOVA. The results of one-way ANOVA calculations with SPSS 20.0:
Table 3. The results of one-way ANOVA Tests

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>3187.813</td>
<td>1</td>
<td>3187.813</td>
<td>22.429</td>
<td>.000</td>
</tr>
<tr>
<td>Intercept</td>
<td>531869.113</td>
<td>1</td>
<td>531869.113</td>
<td>3742.153</td>
<td>.000</td>
</tr>
<tr>
<td>A</td>
<td>3187.813</td>
<td>1</td>
<td>3187.813</td>
<td>22.429</td>
<td>.000</td>
</tr>
<tr>
<td>Error</td>
<td>11086.075</td>
<td>78</td>
<td>142.129</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>546143.000</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>14273.888</td>
<td>79</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on the output, the F value calculated = 22.429 with a significant value less than 0.05. This means a difference in the quality of learning outcomes between students who apply authentic project-based assessments and students who learn with a conventional assessment of online learning systems. The second hypothesis testing is to determine "the difference in the quality of learning outcomes between students who apply authentic project-based assessments and students who learn with conventional assessment in online learning systems after controlling the covariable critical thinking skills." To test the second hypothesis, a one-way ANCOVA analysis was used with SPSS 20.0 with the following results:

Table 4. The Results Of One-Way ANCOVA Test

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>9287.940</td>
<td>2</td>
<td>4643.970</td>
<td>71.719</td>
<td>.000</td>
</tr>
<tr>
<td>Intercept</td>
<td>428.931</td>
<td>1</td>
<td>428.931</td>
<td>6.624</td>
<td>.012</td>
</tr>
<tr>
<td>X</td>
<td>6100.127</td>
<td>1</td>
<td>6100.127</td>
<td>94.207</td>
<td>.000</td>
</tr>
<tr>
<td>A</td>
<td>993.614</td>
<td>1</td>
<td>993.614</td>
<td>15.345</td>
<td>.000</td>
</tr>
<tr>
<td>Error</td>
<td>4985.948</td>
<td>77</td>
<td>64.753</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>546143.000</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>14273.888</td>
<td>79</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on the results of the analysis in Table 3, it is found that the value of F = 15.345, and the significant value is less than 0.05. This means a difference in the quality of learning outcomes between students who apply authentic project-based assessments and students who learn with conventional assessment in online learning systems after controlling the covariable critical thinking skills. The third hypothesis testing is carried out by simple regression analysis, namely by looking at the critical thinking ability variable's contribution to the learning outcomes in students who take learning with project assessment and conventional assessment. To see the magnitude of the contribution of the critical thinking ability variable to learning outcomes, it can be seen from the correlation coefficient (r) and determination coefficient (r²). The contribution of students' critical thinking skills to student learning outcomes in the group that applies authentic project-based assessments, the value of the correlation coefficient is 0.787, and the coefficient of determination is (r²) of 0.620. The value of F = 35,201 with a significance value of 0.00. This means a significant and predictive relationship between critical thinking skills and learning outcomes in students who apply authentic project-based assessments with a contribution weight of 62%. The results of the analysis of the contribution of students' critical thinking skills to student learning outcomes. In the group that implemented the
conventional assessment, the correlation coefficient was 0.693, and the determination coefficient was \( r^2 \) of 0.481. The value of \( F_{\text{cont}} = 62.013 \) with a significance value of 0.00. Thus, it can be concluded that there is a significant and predictive relationship between critical thinking skills and learning outcomes in students who take lessons with conventional assessment with a contribution weight of 48.1%.

From the distribution of response questionnaires distributed to students at the end of the study to find out the responses or responses of students to the application of the assessment given, it is known that as many as 27.50% of students responded very positively, 72.50% of students responded positively, and there were no students who responded sufficiently, less positive, and very less positive towards Online Learning Model Using Project-Based Authentic Assessment. The results of student responses are shown in the following figure;

![Figure 1. Student Responses to the Implementation of Project-Based Authentic Assessments](image)

5. Conclusion

The results showed that: (1) There are differences in the quality of learning outcomes between students who apply authentic project-based assessments and students who study conventional assessments in online learning systems; (2) There are differences in the quality of learning outcomes between students who apply authentic project-based assessments and students who study conventional assessment on online learning systems in terms of critical thinking ability covariables. (3) The results showed that the learning outcomes of students who applied authentic project-based assessments were higher than students who applied conventional assessments. The ability to think critically gives a positive contribution of 62% to student learning outcomes using authentic project-based assessments and a contribution of 48.1% to student learning outcomes using conventional assessment.

References


Students’ Perception toward Unwillingness to Participate in EFL Classroom

Meicy Intan Sari¹, Anisha Ayu Anindya², Mochammad M Romadon³, Bambang Widi Pratolo⁴
{mochammadmuchlisromadon@gmail.com}

Magister of English Education, Universitas Ahmad Dahlan, Indonesia

Abstract. The importance of foreign language is required in this globalization era. English as an international language is a necessary language that has to be possessed by students and professionals. In fact, students might face difficulties on mastering the language. This resulted on students’ willingness to participate the learning. This research aimed to provide a depiction of students’ perceptions toward unwillingness to participate in the English classroom. The researcher uses a qualitative method to describe the data. The subject of this research belongs to EFL graduate students at Universitas Ahmad Dahlan, especially the first semester students in English education department. The result showed that students often reluctant to take part in the EFL classroom due to various matters such as linguistic factors, psycholinguistic factors, socio-cultural factors, and also institutional factors.

Keywords: Student Unwillingness, Student Participation, Speaking, and EFL student’s perception

1 Introduction

In this globalization era, English is an essential language that has to be possessed by students and professionals. In Indonesia, English is instructed as a foreign language. English communication has become a core skill that should be developed in all academic contexts [1]. The common question that arises from anybody who wants to know someone’s ability in a foreign language is whether he/she can speak English well or not. However, EFL (English as Foreign Language) students typically have little chances to connect with people in English due to the lack of practical English practicing contexts, not to mention getting input from others to create reflections [2]. So, fluent in English is required by people to communicate with others. However, to get fluent in English, the EFL students have to study at some levels, from beginner, intermediate, and so on. In line with this, in such programs, the significance of English language learning lies not only in the role of language as one of the primary objectives, but also in its impact on the comprehension of the subject matter delivered in the language[3].

In teaching-learning process, students are being asked to be able to master all skills of English. In fact, not all students can learn English as well as others can do. Some students in the classroom even less enthusiastic in English teaching-learning process. Besides, the teaching methods will also affect student’s ability in learning English. Thus, the researcher is curious about other factors that can affect the willingness of EFL students to participate in English teaching-learning classroom.
To produce and perform compelling, coherent, and critical English skills, communication during learning time and process play a huge role toward EFL students. Emphasize the substance of conversation as students’ ability to express themselves in English inside and outside the classroom is a success indicator to English teaching and learning. Moreover, researchers from other studies Maclntyre, Clement, Dornyei & Noels described the willingness to communicate as “a state of readiness to arrive a talk at a specific time with a particular individual or people utilizing a second language or a foreign language.” [4]. With a big willingness to communicate, learners are searching for ways to use the language and have more language practice than students who are less willing to communicate [5]. In EFL (English as a foreign language) environments, where students are often demotivated to use English because of the ever-present reality that their classmates typically communicate in the same native language, the perceived importance of communication when considering Willingness to Communicate, while it is commonly thought to be important for success in improving communicative competence in second language interaction[6]. Concisely, the willingness to communicate assists EFL students to inform and enhance their English skills.

Moreover, the study of unwillingness participation has been investigated recently by some researchers who interest to research about students’ reticence to participate in English class and another researcher has already conducted a study of problems and difficulties faced by students in participating in English classroom. The research by Savaşı aims to highlight the reasons for reluctance in EFL oral communication classes and the perspectives of learners on this topic [7]. In a Turkish EFL environment, the researcher tries to find out the reasons for reluctance among the students who attend English oral communication courses. A similar study also investigated speaking obstacles faced by the students [8]. The study focused on the difficulties and affected factors faced by English department students of Syiah Kuala University and the efforts that students made to overcome their speaking problems. The result showed that the most problems faced by the students are less confident, lack of vocabulary, low participation in classroom activities, and difficulties in expressing the sentences.

Moreover, another finding has revealed that the difficulties faced by the students are due to fear of making a mistake, anxiety, shyness, and lack of confidence and the study was conducted by Nakhalah at Al Quds Open University [9]. He got the data using interview to investigate the speaking difficulties and causes of such problems of study speaking. A similar investigate was conducted by Mofareh, this section investigates the weak language skills of students of the English language, particularly in terms of their conversational skills and/or ability to achieve the required fluency levels in either the classroom or public sphere[10]. The several factors that directly influence the success of students in fluent English include the fear of making mistakes [11]. The similar result found that 78% of learners like English as a subject, but 90% of learners were afraid to talk because of fear of being wrong, shyness, and humor [12].

The other research about students’ reflection to participate English language oral class. This aims to define the important aspects that inspire or demotivate the engagement of students in an English classroom. In schools, some students are still hesitant. These students' actions can be understood as having insufficient interest in the practice, thereby leading to unwillingness to interact[13].

From those previous studies, the researcher found that most of EFL post graduate students faced obstacles in English classroom subjects which is caused by psychological and linguistics problems. Relating to this, the researcher is interested on conducting the same research that aimed at exploring the barriers of students’ participation in English classrooms encountered by the first-semester students of English education department at Universitas Ahmad Dahlan.
2 Literature Review

2.1. English as Foreign Language

EFL is an abbreviation of ‘English as a Foreign Language’. EFL is described here as a language used only in an EFL classroom setting by non-native English speakers learning English [14]. This program helped 16 years and older students to increase their English. EFL program provides plentiful options based on the student’s English ability, the purpose of the study that they wanted, a program that has been offered by the involved institution, and the intensity of the program. EFL program consists of Cambridge Skill for Life, EFL Intensive, EFL Part-Time, and Preparation for IELTS. EFL program can take place from a few weeks to 10 weeks, and even 30 weeks depends on the student’s tier and plan. Also, there is a part-time and full-time option. The class consists of 10 to 22 students. The students will learn from in-class practice, assignment, and personal study.

2.2. EFL Programme

Depends on the level of study and needs, there are several EFL programs like English for Specific Purpose (ESP), Academic English, and English for Business. a) General English – This program aimed to increase English fluency, but not for academic purposes, just for in general English. The primary purpose of the EFL program is to enhance speaking and listening skill. Learning a foreign language is important at all levels of education [15]. Aside from learning English, students received elective subjects. b) Business English – This program aimed for professional or university graduates to hone their English abilities before entering the workplace. This program is shorter in terms of duration, but more intensive, and focused on the business term. c) Academic English – This program is aimed for students that wish to continue their study to a higher education level so that this program only focused on academic English, like how to write a paper, listening to lecture, and other academic expertise.

2.3. Student Learning Interest

To simplifying the understanding of learning interest, first, we should analyze attention and learning. Interest means self-tendency toward something. Investment is a relative attribute that stays inside someone. On the contrary, without interest, someone will not be able to do what he wants. Whereas in term has been put forward by experts, one of them were stated by Fryer, Luke, Andrew, Kaori, Mark & Andrew that Interest is generally recognized as important both for the initiation of learning and persistence in it. Interest is perhaps best represented as a willingness to rejoin [16].

Sulaiman; Ramli & Kurniawan explain that interest is “a motive that causes an individual to relate to something that attracts them actively [17]. however, it concluded that interest is someone tendency towards the object or some favored activity with pleasure, being care, and exercise to react. Interest in particular areas of learning is both a means of formal education and a significant result [18]. Study achievement is a result obtained by the student through various studying processes to learn something that not yet known, and through learning, they could know, understand, and comprehend better. Study achievement is a result that has been given by the teacher to the student with a specific period as a learning result. Study achievement as
curiosity satisfier. This is based as an assumption that psychology expert usually stated that it is a curiosity tendency and it is humans basic needs, including children needs in an education program [19].

Student achievement level, in general, can be observed from student accomplishment (mastery) to learning subject. If the subject of the study gets less than 65% of students’ understanding, then the student success percentage will likely be reduced. As a general understanding, there are lots of factors that influence study achievement as; intelligence, interest (motivation), concentration, physical health, ambition and determination, environment, learning method, equipment, and negative traits.

A safe and disciplined school environment, optimistic and high hopes from school members, school sanity, and student-centered activity can increase student passion for studying [9]. Various factors influence consider achievement as (1) External and instrumental factors, and the environment consists of nature and society. Helpful consists of curriculum, program, tools, facility, and teachers, and (2) internal factors consist of physiology and psychology. Psychology consists of a student’s intelligence, interest, motivation, and cognitive skill.

It can be concluded that students’ behavior when following the learning process can indicate a student’s interest in the subject, and otherwise, they are not interested in the topic. Student interest is one of a desire to study sign. willingness to consider is a tendency to pay attention and remembering continuously, want to study has a close connection to pleasant feeling, because of that, it can be said that desire to explore has occurred because friendly atmosphere toward something, person that interest to study to some subject means they are feeling pleasure to learn [12].

2.4. Interest Indicator.

2.4.1. Attention

Attention plays an important role in the following activity well, and this can affect student interest in the study. According to Yun., Shin, Kim, Jang, Ha, & Yu, attention is more or less awareness that accompanies some activity (ability to focus in class) [20]. Then Parry, Roux, & Bantjes aid that attention is energy concentration or some spirit power to a certain object or awareness utilization to accompany a certain activity [21].

Activity that accompanied by intense attention will be more successful and leads to higher achievement. Therefore, as a teacher have to make an effort to attract pupil attention, so they have an interest in the subject. A person that putting interest in certain activities will give more attention. They will not hesitate to put more time and effort into that activity. Because of that, a student that has an interest to put more time and effort into that activity. Because of that, a student that has an interest in a particular subject will always try hard to get a good grade through learning.

2.4.2. Feeling

Students feeling toward the subject that is taught is a crucial element. The Feeling is defined as mental symptoms that tend to be subjective that in general connected to knowing and experiencing symptoms with pleasure or not to various degrees [20]. A feeling, happiness, or not will always surround every activity and experience. The passion, in general, is connected with knowing function that means feeling can occur because of observation, assuming, remembering, or considering something. The feeling is referred to as feeling pleasure and attracted. Feeling was a psychic activity that inside it can be found appreciating the value of a particular object [22].
Feeling as a non-intellectual psychic factor that mainly affects passion for studying. If a student conducts a little bit spontaneous assessment through their feeling about the learning experience in school, and that assessment was resulting in a positive outcome, then that will produce a pleasant feeling, but if the result is negative then will cause an unpleasant feeling. Pleasure feeling can create a desire that strengthened by a positive gesture. Meanwhile, uncomfortable feelings can slow the learning process because there is no positive gesture that did not attract the willingness to learn.

2.4.3. Interest to subjects and teacher

Not all students like some issues because of their interest in learning. There is some student that develop their interest to learn because of the teacher’s influence, classmate, and exciting topics. In the long run, if the student can build their interest to learn the subjects, then they will succeed even though they are average students.

Lack of interest in a particular subject can because of why the pupil did not take notes that have been taught by the teacher. It is a sign that the student has a lack of motivation to learn. Because of that, the teacher should be able to raise student’s motivation, so the students have their motivation to learn.

In the learning process, motivation is needed; that is why a person that were not motivated to learn will not make any learning activity. This is a sign that those activities will not touch their needs and everything that attracts interest to some person as long as those did not affect their needs. Because of that, what a particular person sees will raise their attention as long as it is related to their interests. So, motivation is a primary stimulus that boosts learning activity, so they have an interest in particular objects because the benefit is a motivation tool in learning.

2.5. Student Perception

According to Liu, Yoshino, & Mochida perception, in short, means vision, how someone looks for something, whereas in extended means, how someone interprets and articulates something [23]. So & Brush explain that perception is an object that captured and projected in the final part of the brain so that we could observe the object [24]. McDonald interpret that perception is someone observation that derived from their cognition component [25]. The cognition aspect is a transformation driving element since the information that goes through will determine the feeling and will to act. Therefore cognition component will react to someone’s tendency to perform well or not toward something that forms an answer to question what has been considered or perceived about it.

Young & Bruce said that perception involves in two work process that related to each other, first receive impression through vision, touch, and other senses; and second, analyze or interpret the meaning of reactions with definition structure (a relevant belief that emerges from experience) of someone with evaluative structure (values in someone beliefs) [26]. Perception is not an implicit process, because the response to a various assessment of senses sign could be happening below the consciousness threshold. Student perceptions are significant determinants of attempts to enhance higher education learning environments [27].

In this research, the perception will be emphasized to the idea point of view that being done by students to observe and respond to a problem. Therefore, need to be some understanding of the perception that aimed at this research.

2.5.1. Fear of Negative Teacher Traits.

Lecturer traits influence student confidence in classroom discussions. Tanveer stated, “Lots
of past researchers mentioned that negative lecturer traits discourage students participation" [28]. A like from preceding studies, many student participation can be determined by negative lecturer traits such as being impatient and lack of teaching skills according to the present paper. A few of the components that play a role in student reluctance in classroom discussions participation are afraid of being humiliated and criticized in front of classmates. Thereupon, to stay away from any teacher humiliation and criticism, the students would rather stay silent. This outcome is in line with Tanveer who discover that student limitation to the new language will influence student reluctance in the classroom [28].

2.5.2. Student fear of Being Laughed and Making Mistake

Fear of making errors is frequently quoted as another source of passivity and reluctance, and this uneasiness is connected to some Eastern culture aspects such as a requirement to be as perfect as possible and fear of embarrassment [29]. The result of this study matched with this respect too. The participants often express the fear of making errors or mistakes in front of their classmates. The feeling of being incompetent makes them anxious.

2.5.3. Shyness

Shyness was another affecting calculate which might influence students’ support. Shyness can be seen as a problem for impression management and low self-efficacy beliefs about the social success of one[30]. In any case, shyness, agreeing to Zee & Roorda shyness usually refers to the trepidation and wariness of students in the face of new conditions [31]. Juhana said that speaking in front of other people is one of the more common fears that students experience and feeling of shyness makes their mind go blank or that they will disregard what they need to say some time recently[29]. Shy students are likely to doubt and worry about new persons, activities, and conditions, and may feel self-conscious or even humiliated when they feel like they are being socially assessed [32]. Shyness is an enthusiastic thing that confronted by many students when they are inquired to speak English in front of the class.

2.5.4. Fear of Being Volunteered to Answer or Ask a Question in Class

One of the problems encountered by learners is being frightened to speak due to fear of making mistakes. The participants are asked about how they feel about answering and asking the question during the learning process, and a third and more stated that during class, they are frequently afraid of requesting the problem to the lecturer. This is equivalent to Wu that proclaim that “the learners in their studies get anxious on the off chance that they raise comments and questions amid English class” [33].

2.5.5. Fear of Negative Teacher Evaluation

The current study discovers that the source of anxiety in English as a Foreign Language classroom is fear of negative evaluation. The student is concerned because they cannot speak English good enough. Students think that the lecturer will evaluate them negatively if they make a mistake; therefore, they will remain silent, and this perception is very likely due to teaching and practice the teacher employs
3 Method

The researcher applied qualitative method which include 10 EFL students who join EFL class subject and have several attendances in the English classroom. This is the ideal number of participants is around 6-10. Further, the researcher used descriptive qualitative to describe the study on the real-life context in order to explore the obstacles faced by the participants.

Further, the data collection was done through a semi-structured interview. This method allows the interviewer to have structured guidance in hand. In line with this, semi-structure interview is particularly appropriate if the researcher has been familiar with the context and phenomenon and does not want to use ready-made response categories that would limit the depth and breadth of the respondents’ story. After interviewing, the audio was converted into written data via the transcription process, and the data were translated into full English. Regarding the issue of transcription, first process involved reading the raw transcriptional that consist of many pages. After that, the text transcription was being split up into smaller segments to help the researcher to identify or underline the new information related to the topic.

4 Results and Discussion

This research is putting some main factor that affects students’ participation in EFL classroom, such as linguistic factors, psycholinguistic factors, socio-cultural factors, institutional factors. For the further information, the researcher quoted the information gained from participant and provide the explanation with related literature and studies to support the participants’ explanation.

4.1 Linguistic Factors

It occasionally influence students’ participation in classroom activities. The participant stated that the difficulties in utilizing proper grammar, lack of vocabulary, pronouncing English words, and another sort of thing which makes participants reluctant and unwilling to speak or to participate in English classroom. Lack of language structure. The student concedes that they have learned grammar for a long time since they are in primary school until they become a university students. This issue constrains them to talk fluently in English.

“I can’t talk English fluently because the problem confront when talking English is I don’t get it the structure used in some cases. It makes me clear that I overlooked what I need to say before.”(S1)

Lack of vocabulary. This revealed as the other issue that experienced by the students in speaking English. The students stated that they cannot express their thoughts and opinion since they have limited vocabularies. They don't know how to say their words in English well.

“I do not have more words to talk and express the limited words makes me difficult to precise my own words in English. It makes me troublesome to talk in English”. (S2)
Lack of pronouncing English words. Another reason why students are unwillingness to participate in EFL classroom is because they cannot pronounce the words and sentence correctly. They cannot express the divine word to communicate with each other in English.

"When I talk or speak some student are confused about what I pronounce because I failed to say it, and sometimes they laughed at.” (S3)

Low participation in classroom activities. The students are afraid to talk and participate in the classroom because of grammar things and limited of words. They don't get a specific mind and understand the language structure in the right way. It makes them noiseless in the EFL Classroom. They fear in volunteering to ask or answer the questions.

4.2 Psycholinguistic Factors

The second factor that affects the participant’s reluctance to communicate in English is shyness and uneasy feeling. Student sometimes feels shyness when they talk each other in the classroom, and they felt shyness because the student has lack of things in English and makes student afraid to do conversation in English and the impact to student participation in a class, they thought uneasy to talk English as well.

“I felt afraid, and it makes me shyness to talk with other students when I try to talk in English in the class.” (S4)
“I afraid that another student will judge me when I talk in English.”(S5)
“I shyness to talk with my friend. I afraid if they are laughing when I make a mistake.”(S6)

The participants admit that the student was afraid to make a mistake, and it makes them a bit shy though it was reasonable to make a mistake, especially when learning a new language. All of the participants admit that they are afraid of being judged as ‘showing-off’ or ‘arrogant’ when trying to speak English with their friends. They all confessed when they try to communicate in English with friends get haunted with that kind of uneasy feeling.

4.3 Socio-cultural Factor

The third factor is the socio-cultural factor that affects the participants’ to communicate in English. The participants are Indonesian and they came from different culture which makes them tend to use their native language most of the time. The participants feel it demotivated to communicate in English because most of their friends were using their native language or Bahasa Daerah, and that kind of habit influenced the reluctance to communicate in English. In brief, the three participants admitted this kind of situation.

“Sometimes, when I try to talk English with my friends and try to practice in daily activity, but my friends sometimes give a response with Bahasa or Bahasa Daerah (the same hometown)”(S7)

“I made rules with my friends to always talk in English when we are taught, but they almost use Bahasa to respond and when I can practice English directly? No more way to me to fluent in spoken English” (S8)
4.4 Institutional Factors

The fourth factor that affected participant reluctant to communicate in English and participate in EFL classroom is caused by institutional factors such as the lecturer’s teaching method and institution’s rules that were strict and ambiguous. There are no rigid and clear rules during learning and teaching time that oblige all of the students and lecturers to speak English regularly. Besides, there was no punishment for those who violate the rules. The participants also stated that some lecturers still utilize lecturer-oriented teaching methods which means that the lecturer is more active than the students.

“Teacher sometime just explain the subject of study in front of class without give a change students to respond” (S5)

Furthermore, one of the participants confessed that when students communicate in English, particular lecturers tend to criticize them. This will prevent the students to communicate regularly in English.

I feel bad when I try to response the teacher explanations using English, ma teacher cut off ma question in one way and teachers say that my English so bad”(S9) ”

“Teacher explain the object of study, after that teacher give a question, and I try to answer the question and present the re-explanation the subject in front of the class, I use English and missed some vocabulary and structure, you know what happens to me? My score is C, I don’t wanna answer the question anymore” (S10) ”

Moreover, another participant claimed that lecturers are inconsistent when comes it comes to provide a good model for students, such as when the student asks a question in Bahasa, then the lecturer proceeds to follow the student to answer in Bahasa. As a good role model, the lecturers should always speak in English although students still use Bahasa. The participants agreed that institutional factors are one of the most influential factors affecting their unwillingness to communicate more often in English.

This research has discovered some factors that caused students unwilling to participate in EFL classroom. It was found that some of the students are fear of negative teacher traits, and fear of negative teacher evaluation, fear of teacher’s judgment, fear of making mistakes and being laughed, and fear of volunteering to ask or answer a question. This resulted on student participation on English class which make them absent for many times.

This study has explored the students’ perception toward the unwillingness to participate in EFL class subject that encountered graduate students at Universitas Ahmad Dahlan. The most problems faced by the students are fear of negative teacher traits, fear of making mistakes and being laughed at, fear of volunteering to ask or answer a question and fear of negative teacher evaluation. In this current research, the student unwillingness in EFL subject are influenced by Linguistics Factor, Psycholinguistic Factors, Socio-cultural Factors, and Institutional Factors. The Linguistics factor such as lack of language structure, lack of vocabulary, lack of pronouncing English words, low participation in classroom activities. a linguistic factor such as. psycholinguistic factors like Shyness and uneasy feelings, socio-cultural factors that consist a culture and mother tongue, student feels the mother tongue one of the reasons that can choke of student unwillingness to participate or communication in English , and institutional factor, this factor are about a teacher or lecturer’s method of teaching and institution’s rules the that
were strict way rules.

These results are in line with the previous study that student feel unwillingness conclude by Savaşçı the findings showed that several factors such as anxiety, fear of being despised, teacher strategy, and culture have been found to affect the problem of reluctance between speakers [7]. Another researchers’ findings also line with the current study. Herriansyah and Nakah studies’ findings showed that the students not confidence to speak, fear of mistakes, anxiety, shyness, low participation in speaking class are the problems in speaking area [8][9]. However, another research was found that the personality characteristics of the teacher, the communication skills of students, the learning atmosphere, the motivation of students, self-confidence and topical information, and interesting discussion topics play important roles in the involvement of students in the oral class in English [11][12][13]. Mofareh explain that a general weakness in English grammar, vocabulary, syntax, poor fluency in speech, poor understanding of general grammar frameworks, and inaccurate pronunciation were attributed to the percentages varying between average, weak, and very weak [10]. So, it can be said that the most influence factors student feel unwillingness in class based in this below; linguistic factors, psycholinguistic factors, socio-cultural factors, and institutional that factor. Result get more the impact of student to participate in classroom such as; fear of negative teacher traits, fear of making mistakes and being laughed at, shyness, fear of volunteering to ask or answer a question in class and fear of negative teacher evaluation.

In other word, most of students were shown to have a strong unwillingness to take a part on communication using English with the other one. This indicated that most of them had a problem to use the English language in the classroom that impact in their participation to join the class. More importantly, they did not seem to enjoy the whole communication using English with their peers.

5 Conclusion

Based on the research findings and discussion above, the researcher got some conclusions concerning. Then, it could be concluded that the major factors which affected the participants to feel unwilling to communicate more often in English in classroom encountered by first semester students of English Education Department consist into four factors; linguistic factors, psycholinguistic factors, socio-cultural factors, and institutional that factor. The researcher divided the unwillingness student to participate in EFL classroom such as; fear of negative teacher traits, fear of making mistakes and being laughed at, shyness, fear of volunteering to ask or answer a question in class and fear of negative teacher evaluation. Some recommendations were suggested after performing the analysis. Communication skills are not stand-alone, but are accompanied by many things, such as learning vocabulary, grammar and pronunciation, the most important things we need to remember.

Psycholinguistic factors an important role in order to make the students confident and not afraid of making errors and mistake while they are required to communication in front of other people. The researcher suggest to the next researcher who interested to conduct the same case to gain more participants as the subject of the study. Future research will want to explore other
potential explanations for unwillingness student to participate more in classes and include useful strategies to engage EFL students. There is, however, a need for further study in this field, involving more respondents. The lack of time and condition makes the researcher just take limited participant in the first semester students of English Education in Ahmad Dahlan University as a subject in this study.

References

AI and Human partnered task experiences. Learning and Individual Differences, 80(), 101850. doi:10.1016/j.lindif.2020.101850


The Strategy of Character Education Instilment in SDIT Az-Zahra Sragen

Munif Rofiat R. Rohmah 1, Husaini Usman 2
{rofiatur06@gmail.com 1, husainiusman@gmail.com 2}

Education Management, Postgraduate Program, Universitas Negeri Yogyakarta, Indonesia 1, 2

Abstract. This research aims to understand the strategies applied in the instilment of character education in SDIT Az-Zahra Sragen. The research is carried out using a qualitative approach. The data-collecting techniques used in this research are observation, interview, and documentation. The article aims to understand the strategy of character education instilment efforts in SDIT Az-Zahra Sragen. The research shows that character education strategies in SDIT Az-Zahra Sragen are applying breeding activities, the hope of these accustomed activities so that students have a right attitude and get used to it in the school environment, families, and communities; creating character program consisting of clean character and neat, polite, well-mannered, and discipline; forming school officers such as School Health Officers, School Attitude Officers, Love Prayer Officers, and Love Book Officers.

Keywords: Strategy, Character Education, Breeding Activities.

1 Introduction

The instilment of character education in students will be one of the primary duties constantly shouldered by parents and teachers. Concerning this, a specially designed environment plays a significant role in supporting the completion of character education instilment. For example, the school environment atmosphere that promotes a clean character's formation will make it easier for students to have a clean character. It also can be applied toward student character problems resulting from the wrong environment. Just as the delinquency of students occurred in the elementary school in Pulau Rimau which is one of the causes is lacking the supportive environment to create the character of students especially while at home. As for the delinquency, which the previous researcher found in this elementary school include: hiding friend's stationery, asking friend's pocket money, fighting, being absence school without permission or explanation, lying, calling a friend's name by the name of his or her parents, etc. [1].

Character education is an effort to guide human behavior toward normative standards. The effort also gives way to appreciate the perception of personal values manifested at school. The focus of character education is on ethical purposes, but the field's practice includes strengthening essential abilities amplification following students' social development. Character education not only teaches what is right and what is wrong, but more than that, namely instilment a habit of the good so that students can understand, feel, and have willing to do it [2]. From an intense instilment of habit involving the cognitive aspects, affective, and psycho-motorist of a student, the accumulation of good habits slowly becomes a student's
strong character. If good habits become a character, it can quickly be done by students without a second thought. In the future, these mannered students will become part of succeeding generations that contribute positively to the nation and country. Character education should fit into every aspect of the classroom's teaching activities, daily practice of school life and integrated with every school's extracurricular activity. Therefore, each student is expected to be able to apply it in their home and surroundings. All aspects of education from the classroom to home should remain ongoing in maintaining educational character values [3].

The urgency of raising the problem into scientific research is in addition the education aimed to shape students have good character as well as the education requires systematizing and integrated effort that must be fully realized by all the components of schools such as teachers, policymakers, parents, and students. The positive effect of raising this research is in order to be known the strategy of character education applied in the school as the site of research. While the negative effect of not raising this study is the other schools cannot learn and adopt the character education strategy applied in the school in this study.

Integrated Islamic Primary School (SDIT) Az-Zahra Srangen, Central Java, Indonesia, is one of The Integrated Islamic Primary School that implements character education programs. The importance of researching the strategy of character education instilment in SDIT Az-Zahra Srangen is because, in addition to SDIT Az-Zahra as Srangen's Integrated Islamic Primary School pioneer, it also has an integrated character instilment from the curriculum and daily practice whether when students are in the school or at home. So that, this article aims to understand the strategy of character education instilment efforts in SDIT Az-Zahra Srangen.

2 Method

The study uses a qualitative research method. The study was conducted in SDIT Az-Zahra Srangen, located in Srangen District, Sragen Regency, Central Java, Indonesia. The data sources in this study are the principal, teacher, and parents of students in SDIT Az-Zahra Srangen. The data-collecting techniques used in this study are interview, observation, and documentation. The data collecting is done with interviews with the school principal, teachers, and students’ parents and then reinforced by observation and documentation. Data analysis measures include (1) data reduction, which is data grouping process that corresponds with the focus of the research goal; (2) data display, namely data is presented in the text narratively in the form of a brief description of character education instilment strategy in SDIT Az-Zahra Srangen; (3) conclusion drawing based on the presented data.

3 Result and Discussion

3.1 The Strategy of Character Education Instilment in SDIT Az-Zahra Srangen

3.1.1 Applying Breeding Activities

The process of a breeding character in SDIT Az-Zahra Srangen is held at the beginning of the school year. In a full week, students are taught breeding while in school. The concept of breeding is teaching breeding activities should be done when students are in school. The
concept of breeding character includes the first, students must say salam when coming to school with a smile then sniff at teachers’ hand, the second, students must take off shoes and put on a shoe rack and so on when they enter to the classroom. Besides that, students are also taught ethics in the teachers’ office, in the mosque, in the toilet, etc.

The purpose of the breeding activities in SDIT Az-Zahra Sragen is to introduce students to how to behave when they are in the school and make the school one of the places to do the breeding. This breeding is done through school learning, and then students can also do it both at home and in the community. In order to instill character education contained of moral values which is included in the realm of affection, breeding has a crucial role. Because values cannot be taught, values can only be practiced. It is such emphasized by Abdul Rohman [4].

While at home, the supervising character activity model is with the supervision and monitoring by students’ parents. Parents are obliged to monitor the children's character activities by the school character checkbook. According to Supraptingrum and Agustini, besides knowing more about children's character, the supervision is less likely to be minimized lousy character because of total parental supervision [5]. Based on Agus Setiawan’s opinion, the school effort to involve parents in instilment character education is the right thing to do by the school. It causes parent or family is one of the components of the educational network besides school and community as a broader environment [6]. Then the more important according to Cut Zahri is that the role of the parent is a very big and lasting influence because the parent and child relationships last a lifetime, it can’t be broken by anyone or any cause. In other words, parent and child relationship is a significant special relationship [7].

As for the hope of that breeding, students can carry it out as well when they are in the home and the community. The breeding of characteristics in the small environment, such as in school and home, as Wolfgang and Marvin emphasized, can later be applied to domestic life as the basis for social, emotional competence in self-management and the social competence needed in practical social life [8].

3.1.2 Creating Character Program

The efforts done by SDIT Az-Zahra Sragen to instill character in students is by forming a character team. The character team handles the principal character to be presented and impressed upon the students. The way to instill such characters is: 1) Creating character slogans pasted around a school environment; 2) Always presenting the characters should be done in school ceremony and classroom. According to Sudrajat, the attachment of character slogans in the school environment is a form of reinforcement of school's high-priority character values. Such an environmental setting could support for the shaming of good deed’s atmosphere in school life [9].

The characters consist of clean character and neat, polite, well-mannered, and discipline. The method used to teach the character is by giving examples. This character program is also included in the Lesson Plan. For example, based on the teacher's standard is to begin a lesson must be clean and neat, then close learning must also be clean and neat. Character programs in SDIT Az-Zahra Sragen hope that all teachers, administrators, and students in SDIT Az-Zahra Sragen can show an excellent example following character programs already applied in the school. This character program is also expected that students will eventually become clean, neat, polite, well-mannered, and disciplined individuals.
The school environment should support the development of character education by creating such a situation and an appropriate learning environment for students. Learning is more emphasized in active learning and more effectively in developing of students’ basic ability and implementing students’ discipline in elementary school [10]. Character education program implemented in the school should get support from various components, because basically the character education will achieve optimal result if it is supported by families, schools, and society [11].

This applicable and repeated character program in SDIT Az-Zahra Sragen will form a firmly embedded school system, especially in a school environment, if parents, teachers, and policyholders commit and work together to promote students’ to manifest character education values in their daily lives [12]. In shaping students’ character, the character that will be shaped must be repeated. For example, shaping the student's disciplined character. The character of discipline will be shaped when the students repeat it. If done repeatedly, then the student will get used to having disciplined behavior [13].

In more detail, the school system will be imprinted throughout the school community, especially teachers and students, if it is presented continuously and done. Parents who have the duty of supervising their children after school have likewise done much to reinforce the school system. Outside the school environment, schools will be known to the public as a school of such character values that it will indirectly become the appeal of other parents to send their children to SDIT Az-Zahra Sragen.

3.1.3 Forming School Officers

These school officers in SDIT Az-Zahra Sragen are formed at the beginning of the school year. Then, in the first week of it, the class board structure selection is also to be done. Names of the classes in SDIT Az-Zahra Sragen use the Islamic State names, and the chief of the class is called class president. That makes the class unique. Students who are not selected in the class board will become school officers. In each class, the school officers consist of two boys and two girls. School officers formed in SDIT Az-Zahra Sragen are School Health Officers, School Attitude Officers, Love Prayer Officers, and Love Book Officers. The purpose of creating school officers in SDIT Az-Zahra Sragen is to teach children students to be honorable, responsible, and to be motivated to keep their good and spread the good on to other friends.

School officials who take from students are an effort of very useful character instilment. This is because students will learn directly and feel their means to be a mandate and responsible when getting the duties. From here, it is understandable that the instilment of character education in SDIT Az-Zahra Sragen is in the level of realization stage. Essentially, this character education realization is the most core activity of character instilment efforts [14]. Through the character education, students are expected to be able to independently improve and use their knowledge, assess, internalize, and personalize the noble character and moral values so that they can manifest in everyday behavior [15].

School officers in SDIT Az-Zahra Sragen are taken from 4th grade students and 5th. The companion is from 6th grade. In the meantime, 1st grade students, 2nd, and 3rd become the participants. The school officials officiated according to a set schedule. The School Health Officers are on duty to check the students' health/hygiene in the classroom. The School Attitude Officers are on duty to keep students’ attitude order. The Love Prayer Officers have the duty of organizing students while praying in the mosque into order. The Love Book Officers have the duty of modeling other students to love reading books and visiting the
The goal of creating school officers in SDIT Az-Zahra Sragen is to improve students' attitudes for the better.

In principle, the implementation of strategy character education values toward students' school is not strictly regulated. However, the important is how character values are understood, embedded, and expected to become permanent behavior in each student [16]. As the above description, SDIT Az-Zahra Sragen is a primary school that implements a character education strategy to the field's level of execution mechanisms. Such real efforts will undoubtedly open more significant opportunities for instilling character education in students.

4 Conclusion

Based on the above research, it could be concluded that strategy character education instilment in SDIT Az-Zahra Sragen, namely: 1) applying breeding activities. The purpose of breeding activities is for the school to be one of the places to do breeding and hope students can also do it both at home and in the community; 2) creating a character program. The school's applied character consists of clean character and neat, polite, well-mannered, and discipline; 3) forming school officers. School officers formed in SDIT Az-Zahra Sragen are School Health Officers, School Attitude Officers, Love Prayer Officers, and Love Book Officers. The purpose of forming school officers is to teach students to be honorable, responsible, and motivated to keep their good and spread the good on to other friends.

References


Analogy Supported-Scientific Explanation Text to Improve High School Students’ Understanding of The Concept of Heat Transfer

D Nurdiansah¹, A Suhandi, and R Efendi²
Physics Education Program, Sekolah Pascasarjana UPI, Bandung, Indonesia
¹{nurdiansahdian33@upi.edu}

Abstract. Low understanding of concepts is one of the classic problems faced in learning physics in senior high schools. This research was conducted to test the use of analogy supported scientific explanatory text (AS-SEText) in learning physics to obtain depiction about its effectiveness in improving senior high school students' conceptual understanding of the heat transfer concepts. Scientific Explanatory text is written in computer format and analogy used to support text in the form of dynamic analogies packaged in a video analogy. The method used in this study was pre-experiment with a one group pretest-posttest design. The research subjects were 40 students from one high school in West Java Province. The data collection instrument used in this research was the conceptual understanding test related to the concept of heat transfer. The results showed that the use of AS-SEText could facilitate more than 70% of senior high school students to achieve an understanding of the concept of conduction, convection and radiation at the sound understanding level. These results indicate that the use of analogy supported scientific explanatory text has a high effectiveness in facilitating senior high school students to achieve sound understanding levels related to concept of heat transfer. There is no gender bias in achieving a level of sound understanding through the implementation of AS-SEText in heat transfer concept.

Keywords: Dynamic Analogy, Level of Conceptual Understanding, High School Students, Heat Transfer Concept.

1 Introduction

Understanding the concept is one of the learning outcomes that must be achieved properly by high school students. Understanding the concept of physics in sound will be a very valuable basic asset when they solve problems related to concept application. Sound understanding of physics concept is also very useful when they are trying to explain the physical phenomena they observe in their environment. In the high school education curriculum, conceptual understanding is one of the competencies that students must achieve after participating in
physics learning. Therefore, physics teachers are required to be able to organize lessons that can facilitate the building of conceptual understanding among students.

In the context of instruction, there have been many physics learning models that can be used by high school teachers to build an understanding of the physics concepts. Likewise for observation activities in the laboratory, various designs of practicum activities that are oriented towards building conceptual understanding have been developed. However, various learning models and the design of these practicum activities become less useful when there is a Covid-19 pandemic as is currently happening, which requires restrictions on human interactions, including teacher and student interactions in face-to-face interaction.

One alternative that can be used to overcome this problem is to provide learning materials in the form of text that can be used by students when participating in distance learning in their homes. The required text is interactive text. Text is a lingual unit that is provided in writing or orally with a certain organizational structure to express meaning contextually. There are various types of text, including: descriptive text, discussion text, explanatory text, exposition text, narrative text, negotiation text, procedural text and others (KBBI, 2010). One of the texts that can be used to improve students' understanding of the content and various scientific phenomena is the Scientific Explanatory Text or is abbreviated as SEText.

However, the use of text in which it only presents verbal narratives assisted by static images is considered to be of little help in the process of planting physics concepts related to abstract and microscopic physics content. In fact, there are a lot of physics subject matter that high school students have to study with such characteristics. Heat transfer, electricity, gas kinetic theory, are examples of microscopic and abstract subject matter in physics. Pfundt & Duit (2009) stated that the main difficulties experienced by students in studying electrical and magnetic content in physics learning are caused by the abstract nature, complexity, and microscopic features of the content.

To be able to describe a microscopic phenomenon that is difficult to understand, a representation is needed that can visualize the invisible microscopic phenomena in real terms. One representation that can be used for this purpose is an analogy representation. Harrison and Coll (2008) state that analogy is a process of comparing an object/idea/event with other objects/ideas/events that have similarities. An analogy includes two components, namely analog and target. Analog is a familiar situation or object, which is used to describe situations or objects that are not familiar or new situations or new objects that are not familiar, which are called targets. Analogy is a mode of representation, which can be used as a communication tool to model microscopic phenomena so that students can easily understand them. Analogy is divided into two types, there is a static analogy which is depicted in a static image, and there is a dynamic analogy, which is visualized in the form of analogy simulation or analogy video. For physical content containing microscopic phenomena, the use of dynamic analogies is more advantageous than the use of static analogies.

For the purpose of building an understanding of microscopic and abstract subject matter, SEText can be innovated by incorporating dynamic visual media features, such as dynamic analogies. When a dynamic analogy is included in SETeks as a conceptual aid tool, SEText is now supported by a dynamic analogy. Furthermore, SEText which is supported by this dynamic analogy is called Analogy Supported-Scientific Explanatory Text (AS-SEText).

This paper describes the process and research results related to the implementation of AS-SEText in physics learning about Heat Transfer content. The research was conducted to answer the following questions: 1) How is the effectiveness of using AS-SEText in facilitating the achievement of a sound understanding level by high school students regarding the concepts of
Heat Transfer? 2). Is there a gender bias in achieving a sound understanding level in the implementation of AS-SEText?

2 Methods

This study used a pre-experimental method with a one group pretest-posttest design. With this design, at the time before and after giving treatment in the form of AS-SEText implementation, pretest and posttest were carried out on subjects to identify the level of understanding of high school students related to the heat transfer concept. The one group pretest-posttest design is shown in Figure 1.

Table 1. The research design used in the study

<table>
<thead>
<tr>
<th>Pretest</th>
<th>Treatment</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>X</td>
<td>O</td>
</tr>
</tbody>
</table>

Here O is the level of concept understanding test and X is the treatment in the form of AS-SEText implementation. The subjects of this study were 40 students (24 female and 16 male) from one high school in West Java Province. The data collection instrument used was a test of the level of understanding related to the concepts of convection, conduction and radiation in the essay form.

The level of conceptual understanding reviewed in this study consists of five levels, namely; sound understanding, partial understanding, partial understanding with contain alternative conceptions, alternative conceptions, and do not respond (Kurnaz 2015). To determine the level of conceptual understanding of the students based on the answer data of the concept understanding level test, it was used guidelines as shown in Table 1 and Table 2.

Table 2. Conceptual understanding test scoring rubric for the verbal-type test (Kurnaz, 2015)

<table>
<thead>
<tr>
<th>Conceptual Understanding Level</th>
<th>Score</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound understanding (SU)</td>
<td>4</td>
<td>The response given contains all the components of the answer that can be accepted scientifically.</td>
</tr>
<tr>
<td>Partial Understanding (PU)</td>
<td>3</td>
<td>The response given contains only part of the answer components that can be scientifically accepted from all the expected answer components.</td>
</tr>
<tr>
<td>Partial Understanding with Alternative Conception (PU-AC)</td>
<td>2</td>
<td>The response given contains some components that are scientifically acceptable, but some components of the other answers indicate an alternative conception.</td>
</tr>
<tr>
<td>Alternative Conception (AC)</td>
<td>1</td>
<td>The responses given, all of which cannot be accepted scientifically, contain answers that do not make sense or contradict scientific conceptions.</td>
</tr>
</tbody>
</table>
Table 3. Conceptual understanding test scoring rubric for the picture-type test (Abraham et al., 1992) dan Sağlam Arslan, 2010

<table>
<thead>
<tr>
<th>Conceptual Understanding Level</th>
<th>Score</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Respond (NR)</td>
<td>0</td>
<td>No response, irrelevant response, or unclear response.</td>
</tr>
<tr>
<td>Sound understanding (SU)</td>
<td>4</td>
<td>The depicted image reflects all scientifically acceptable components.</td>
</tr>
<tr>
<td>Partial Understanding (PU)</td>
<td>3</td>
<td>The depicted image reflects only a few scientifically acceptable components.</td>
</tr>
<tr>
<td>Partial Understanding with Alternative Conception (PU-AC)</td>
<td>2</td>
<td>The picture depicted reflects some scientific components but some parts contain unscientific depictions.</td>
</tr>
<tr>
<td>Alternative Conception (AC)</td>
<td>1</td>
<td>The picture depicted reflects the whole section contrary to scientific conceptions.</td>
</tr>
<tr>
<td>No Respond (NR)</td>
<td>0</td>
<td>Blank (not drawing).</td>
</tr>
</tbody>
</table>

AS-SETText used as treatment in this experimental study consisted of three main parts, namely: part 1, the text of presenting scientific phenomena related to concepts; section 2, scientific explanatory text, and part 3, concluding text. AS-SETText is written in macromedia flash format, so it can be supported by dynamic visual media features such as dynamic analogy video. An example of a dynamic analogy video used to support part 2 of the AS-SETText, namely the scientific explanation text is shown in Figure 2.

![Figure 1](image-url). An example of analogy video used to support part 2 of AS-SETText related to the concept of conduction
3 Results and Discussion

3.1 Results

Table 4 shows the number of male and female students at each level of understanding related to the concept of conduction before and after the implementation of AS-SEText.

Table 4. The number of students at each level of understanding related to the concept of conduction at the time before and after the implementation of AS-SEText.

<table>
<thead>
<tr>
<th>Level of Understanding</th>
<th>Before Implementation of AS-SEText</th>
<th></th>
<th></th>
<th>Before Implementation of AS-SEText</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>M</td>
<td>F</td>
<td>M</td>
<td></td>
<td>F</td>
</tr>
<tr>
<td>SU</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>SU</td>
<td>18</td>
</tr>
<tr>
<td>PU</td>
<td>8</td>
<td>6</td>
<td>33,0</td>
<td>37,0</td>
<td>PU</td>
<td>3</td>
</tr>
<tr>
<td>PU-AC</td>
<td>5</td>
<td>3</td>
<td>21,0</td>
<td>19,0</td>
<td>PU-AC</td>
<td>2</td>
</tr>
<tr>
<td>AC</td>
<td>4</td>
<td>4</td>
<td>21,0</td>
<td>25,0</td>
<td>AC</td>
<td>0</td>
</tr>
<tr>
<td>NR</td>
<td>6</td>
<td>3</td>
<td>25,0</td>
<td>19,0</td>
<td>NR</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>16</td>
<td>100,0</td>
<td>100,0</td>
<td>Total</td>
<td>24</td>
</tr>
</tbody>
</table>

Based on the data in Table 3, it can be seen that there is an increase in the level of conceptual understanding among male and female students between before and after the implementation of AS-SEText. The number of female students who reached the sound understanding level was 75.0% while the number of male students who reached the sound understanding level was 81.0%. It appears that the percentage of female and male students who reach the level of sound understanding related to the concept of conduction is almost the same. Table 5 shows the number of male and female students at each level of understanding related to the concept of convection before and after the implementation of AS-SEText.

Table 5. The number of students at each level of understanding related to the concept of convection at the time before and after the implementation of AS-SEText.

<table>
<thead>
<tr>
<th>Level of Understanding</th>
<th>Before Implementation of AS-SEText</th>
<th></th>
<th></th>
<th>Before Implementation of AS-SEText</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>M</td>
<td>F</td>
<td>M</td>
<td></td>
<td>F</td>
</tr>
<tr>
<td>SU</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>SU</td>
<td>19</td>
</tr>
<tr>
<td>PU</td>
<td>9</td>
<td>6</td>
<td>37,0</td>
<td>37,0</td>
<td>PU</td>
<td>3</td>
</tr>
<tr>
<td>PU-AC</td>
<td>4</td>
<td>4</td>
<td>17,0</td>
<td>25,0</td>
<td>PU-AC</td>
<td>1</td>
</tr>
<tr>
<td>AC</td>
<td>6</td>
<td>4</td>
<td>25,0</td>
<td>25,0</td>
<td>AC</td>
<td>0</td>
</tr>
<tr>
<td>NR</td>
<td>5</td>
<td>2</td>
<td>21,0</td>
<td>13,0</td>
<td>NR</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>16</td>
<td>100,0</td>
<td>100,0</td>
<td>Total</td>
<td>24</td>
</tr>
</tbody>
</table>
Based on the data in Table 4, it can be seen that there is an increase in the level of conceptual understanding among male and female students between before and after the implementation of AS-SEText. The number of female students who reached the sound understanding level was 84.0% while the number of male students who reached the sound understanding level was 82.0%. It appears that the percentage of female and male students who reach the level of sound understanding related to the concept of conduction is almost the same too. Table 6 shows the number of male and female students at each level of understanding related to the concept of radiation before and after the implementation of AS-SEText.

Table 6. The number of students at each level of understanding related to the concept of radiation at the time before and after the implementation of AS-SEText

<table>
<thead>
<tr>
<th>Level of Understanding</th>
<th>Number of Students Before</th>
<th>Level of Understanding</th>
<th>Number of Students After</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>SU</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PU</td>
<td>7</td>
<td>5</td>
<td>29,0</td>
</tr>
<tr>
<td>PU-AC</td>
<td>6</td>
<td>5</td>
<td>25,0</td>
</tr>
<tr>
<td>AC</td>
<td>6</td>
<td>4</td>
<td>25,0</td>
</tr>
<tr>
<td>NR</td>
<td>5</td>
<td>2</td>
<td>21,0</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>16</td>
<td>100,0</td>
</tr>
</tbody>
</table>

Based on the data in Table 4, it can be seen that there is an increase in the level of conceptual understanding among male and female students between before and after the implementation of AS-SEText. The number of female students who reached the sound understanding level was 84.0% while the number of male students who reached the sound understanding level was 82.0%. It appears that the percentage of female and male students who reach the level of sound understanding related to the concept of conduction is almost the same too.

From Table 4 to Table 6, it can be seen that the number of male and female students who reach sound understanding level related to the three concepts of heat transfer is almost the same. This result is confirmed by the difference test between the two mean scores of the conceptual understanding test related to the concept of heat transfer achieved by female students and male students using the Mann-Whitney statistical test at the level of confidence (α = 0.05), as shown in the table 7.

Table 7. Results of the difference test of the average score of the conceptual understanding test related of the concept of heat transfer test scores achieved by female and male.

<table>
<thead>
<tr>
<th>Levels of Sound Understanding</th>
<th>Mann-Whitney U</th>
<th>Asymp. Sig.</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept of Conduction</td>
<td>0.684</td>
<td>0.14</td>
<td>Not significantly different</td>
</tr>
<tr>
<td>Concept of Convection</td>
<td>0.464</td>
<td>0.08</td>
<td>Not significantly different</td>
</tr>
<tr>
<td>Concept of Radiation</td>
<td>0.548</td>
<td>0.11</td>
<td>Not significantly different</td>
</tr>
</tbody>
</table>
In Table 7, it can be seen that the asymptotic significance (Sig) value obtained from the Mann-Whitney statistical test for all three concepts is greater than the appointed confidence level ($\alpha = 0.05$). This shows that there is no significant difference in the mean score of the conceptual understanding test of conduction, convection and radiation achieved by male and female students. These results indicate that there is no gender bias in achieving the level of sound understanding through the implementation of AS-SEText related to the concept of conduction, convection and radiation.

The results of data processing and analysis show that the use of AS-SEText in learning the concept of heat transfer at the high school level has high effectiveness in facilitating the achievement of sound understanding levels by students. This is shown by the percentage of the number of students who reached the sound understanding level of the three heat transfer concepts, all above 70%. These results indicate the good potential of using text as an alternative mode of learning physics at the high school level during the Covid-19 pandemic, where there are restrictions on direct interaction between teachers and students. Several previous researchers who have examined the effectiveness of using text mode in physics learning both for the purposes of building conceptual understanding and for remediation of misconceptions, include: Suhandi et al (2020), Sahin et al (2010), Yumusak et al (2015), and Ozkan & Selcuk (2015).

The good potential of using AS-SEText in facilitating the achievement of a sound understanding level is supported by the presence of a dynamic analogy presented in part 2 of the AS-SEText, which is part of the scientific explanation of the natural phenomena being reviewed. The presence of dynamic analogies in the text can help visualize microscopic phenomena that cannot be observed (abstract) into observable phenomena, so that it will be easier for students to understand.

The results of previous research show that when analogies are used systematically in science learning which contains abstract phenomena, students' understanding will increase (Dilber & Duzgun, 2008). The results of this study are also in line with the results of research obtained by Harrison (1993) who reported that some abstract concepts in science such as pressure, electric current, atomic structure and others can only be taught adequately by using analogy. Being a conception technique, analogy plays an important role in strengthening students' understanding of concepts in a meaningful way and learning in science education (Aykutlu & Şen, 2011; Gentner & Smith, 2012). Analogy is often used to make abstract scientific concepts more understandable to students (Chiu & Lin, 2005). Because analogy is a way of matching newly learned knowledge with those already in students' long-term memory (Karadoğu, 2007).

The use of analogy will improve students' conceptual understanding (Dilber & Duzgun, 2008). For example, it was reported that when analogies were used in teaching scientific concepts such as electricity (Dilber & Duzgun, 2008), pressure (Demirci Güler, 2007; Wong, 1993), and heat conduction and wave properties of light (Harrison & Treagust, 1993), positive changes occur in the achievement of learning outcomes as well as increased understanding of concepts and improvement of their attitudes towards scientific concepts.

The results of the research on the implementation of AS-SEText in Physics learning subject matter heat transfer did not produce gender bias. The implication is that AS-SEText is suitable to be applied to high school students in Indonesia where in the class it does not separate female students and male students, but is united into one study group. Although according to Ali (2019) that in achieving competency in learning outcomes, gender may or may not be influential, but in terms of cognitive learning outcomes, especially regarding conceptions and conceptual understanding, many researchers show that gender does not have a significant effect, thus either. Female students and male students have equal opportunities to achieve scientific conception and
sound understanding level. Research conducted by Saleh and Mazlan (2019) shows that gender has no effect on the achievement of conceptual understanding by students. In line with that, the results of research conducted by Odelphus and Omeodu (2016) also show that there is no gender bias in achieving the level of sound understanding among students in learning physics. Other researchers who also obtained similar results in their research include: Ogunleye and Babajide (2011), Ivowi (1983), Inyang and Jegede (1991), Hyde and Linn (1988) that gender has no significant effect on achievement scientific conception and sound understanding level by students.

4 Conclusion

Based on the results of data analysis, it can be concluded that the implementation of AS-SEText written in macromedia flash format has high effectiveness in facilitating the achievement of the level of sound understanding by high school students regarding the concept of heat transfer. There is no gender bias in achieving a level of sound understanding through the implementation of AS-SEText.

Acknowledgments. The author would like to thank the Muhammadiyah University of Purworejo, The Chancellor who has facilitated the research process and also the lecturer who facilitated the publication of my articles at the conference. Hopefully this article will be of use to all of the following researchers.

Reference


Analysis of Students’ Mathematical Communication Ability Based on Mathematical Resilience during the Covid-19 Pandemic

Afroh Mahfudoh Al'atif¹, Nanang Priatna², Yaya Sukjaya Kusumah³, Suhendra⁴
{afrohalatif@upi.edu¹, nanang_priatna@upi.edu², yayaskusumah@yahoo.com³}

Mathematics Education Study Program, School of Postgraduate, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia¹
Mathematics Education Department, School of Postgraduate, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia²,³

Abstract. Students are faced with new global learning challenges in the Covid-19 pandemic. Likewise, education in this global era has transitioned to 21st-century skills, one of the 21st-century skills that students must be possessed, namely mathematical communication ability. Mathematical communication ability is influenced by several factors, such as students' psychological aspects. One of those psychological aspects is mathematical resilience. This study aims to describe students’ mathematical communication ability based on mathematical resilience in a Covid-19 pandemic due to pandemic. Based on the study objectives, this study used descriptive qualitative research. Data collection techniques used test of mathematical communication ability, questionnaire of mathematical resilience, and interview. The results showed that the students' mathematical communication ability was quite good, based on students' mathematical resilience. Still, there were some difficulties that students experienced due to limited learning during the Covid-19 pandemic.

Keywords: Mathematical Communication Ability, Mathematical Resilience, Covid-19 Pandemic

1 Introduction

Since the beginning of 2020, Covid-19 reports have been taking place worldwide, especially in Indonesia. This Covid-19 case was initially suspected of pneumonia with the first appearance from Wuhan province, China [1][2]. Covid-19 is caused by acute respiratory syndrome coronavirus 2 (Severe Acute Respiratory Syndrome Coronavirus 2 or SARS-CoV-2) and infectious disease [3][4]. Because it is contagious, it is feared that it will spread rapidly if there is frequent and direct social interaction, so the government has suggested a condition where everyone should keep their distance from each other and not interact with each other.

The Covid-19 pandemic has changed almost all areas of life throughout the world, one of which is in education, and the Indonesian state is none other than participating in this change [5]. This pandemic has made educational activities change drastically, where the learning period in both schools and colleges has shifted from face-to-face learning to online learning. The government decided to close schools and colleges. Face-to-face meetings were also eliminated to minimize the spread of Covid-19. This is indeed surprising for most educators and parents,
even though the government and school principals have been wary of news of the Covid-19 virus from outside China. So that a consequence, the government and related institutions at least look for alternative ways to continue learning during the pandemic with the creation of a distance learning curriculum [6].

Students face new global learning challenges during the Covid-19 pandemic, especially in mathematics learning, where they learn by applying online learning methods at home. Mathematics learning, which is usually done directly in schools through teacher explanations using PowerPoint or blackboard, has now turned into online learning. This learning is still considered unusual for students because it is done through online platform such as Edmodo, Zoom, Google Classroom, or other online learning platform. This becomes a challenge for students to work harder in understanding mathematics learning material because many students are still not trained in online learning platform and still confused by the material explanation in the form of video learning [7]. With new global learning challenges, students can benefit from studying at home, spending time with family, and avoiding the Covid-19 virus. However, on the other hand, it also harms students, they tend to be bored and lazy with the homework given by their teacher, want to go to school immediately, and most students feel unhappy with distance learning [8]. This dramatically affects learning mathematics. They tend to be lazy and complain when given consecutive assignments, lack understanding of the learning material, and obtained, especially in pictures.

Besides being faced with distance learning methods, students have also entered a global era transitioning to 21st-century skills. As explained in 21st-century skills, students must have four competencies called 4C, one of which is mathematical communication ability. Lomibao revealed that mathematical communication ability allows students to express their ideas, describe, and explain mathematical concepts coherently and clearly [9]. With mathematical communication ability, students are challenged to communicate their ideas both in writing and orally to friends, teachers, or others so that it will encourage students to think and reason so that their ideas are expressed through writing, diagrams, tables, pictures, algebraic, as well as verbal. Using the correct mathematical language to speak and write about what they do, they will be able to clarify their ideas and learn how to make convincing arguments and present mathematical ideas [10][11].

Students can be said to have good mathematical communication ability if they can meet mathematical communication ability indicators. Mathematical communication indicators are several mathematical activities; according to Sumarmo, the details of indicators include: connecting real objects, pictures, and diagrams into mathematical ideas; explain mathematical ideas verbally with pictures; express everyday events in mathematical symbols; listening, discussing and, writing about mathematics; read with the understanding of a written presentation and make conjectures, construct arguments, formulate definitions and generalizations [12]. Mathematical communication ability is influenced by various factors, such as students' psychological aspects in the learning process. One of the psychological aspects is mathematical resilience. Some students still feel anxious about learning mathematics and the situation during this pandemic, which can make it difficult for students to ask questions directly due to limited time in learning. Mathematical resilience is a positive attitude to overcome anxiety, fear in facing challenges and difficulties in learning mathematics, including hard work and good language skills, self-confidence, and diligence in facing difficulties [13]. Students who have good mathematical resilience think that learning mathematics is not an obstacle. Even when students experience difficulties, they will maintain their confidence until success [14].

In delivering mathematical communication, it is necessary to have a positive attitude in dealing with anxiety and fear when students give different answers. Because without this
positive attitude, students will feel anxious if the delivery of the answers they give is wrong, so students prefer not to express their ideas and prefer to be silent. Rahmatiyya argues that students often feel uncomfortable, tense, or do not like learning mathematics, especially in working on difficult questions; they tend not to ask their teachers or friends [15]. Moreover, because of this online learning, students’ comfort in learning is essential because interaction with the teacher is quite limited, so they must handle their mathematical resilience and mathematical communication ability.

Based on the explanation above, the purpose of this study is to describe students’ mathematical communication ability based on mathematical resilience during the Covid-19 pandemic.

2 Method

The descriptive qualitative analysis approach is the methodology used in this study. The study began with making an instrument in the form of a mathematical communication test consisting of three essay questions, a mathematical resilience questionnaire containing 30 statements and distributed online, and interviews conducted via Zoom. Seven students of 10th-grade high school were given a mathematical communication ability instrument test for data collection and continued by filling out a mathematical resilience questionnaire. After giving the test and non-test instruments, students were interviewed via Zoom regarding the difficulty of the questions they had worked on to strengthen their test and questionnaire results.

The mathematical resilience questionnaire was adapted from (Maesaroh & Sumarmo, 2019) with the following indicators: (1) perseverance, confidence, working hard, not easily giving up in facing problems, failures, and uncertainties; (2) willingness to socialize, easy to assist, discuss with peers, and adapt to their environment; (3) showing curiosity, reflecting, researching, utilizing various sources; (4) having language skills, self-control and be aware of their feelings; (5) using the experience of failure to build self-motivation [16]. However, out of 34 statements on the questionnaire adapted, only 30 statements were used as non-test instruments. Each statement from the mathematical resilience questionnaire has four answer options, namely strongly agree (SS), agree (S), disagree (TS), and strongly disagree (STS). After being tested, the questionnaire results were analyzed to determine which students had high, medium, and low resilience. The step of categorizing the resilience questionnaire in the study is looking for the lowest and highest values, looking for the ideal mean (M), which is ½ (highest value + lowest value), and looking for the standard deviation (SD), which is 1/6 (highest value - lowest value) [17]. Based on these steps, calculations are carried out, as shown in Figure 1 and Table 1.

| Highest score | 30 × 4 = 120 |
| Lowest score | 30 × 1 = 30 |
| Ideal mean (M) | \( \frac{1}{2} \times (120 + 30) = 75 \) |
| Deviation standard (DS) | \( \frac{1}{6} \times (120 - 30) = 15 \) |
| Interval between categories is (M + 1SD) and (M − 1SD) |
| M + 1SD = 75 + (1 × 15) = 90 |
| M − 1SD = 75 − (1 × 15) = 60 |
Fig. 1. The calculation to determine the intervals of mathematical resilience

<table>
<thead>
<tr>
<th>Interval</th>
<th>Interval</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>X &lt; M − 1SD</td>
<td>X &lt; 60</td>
<td>Low Resilience</td>
</tr>
<tr>
<td>M − 1SD ≤ X &lt; M + 1SD</td>
<td>60 ≤ X &lt; 90</td>
<td>Medium Resilience</td>
</tr>
<tr>
<td>X ≥ M + 1SD</td>
<td>X ≥ 90</td>
<td>High Resilience</td>
</tr>
</tbody>
</table>

The results of mathematical communication tests were analyzed by calculating the percentage, as shown in [18] in Table 2.

Table 2. Categorization of mathematical communication

<table>
<thead>
<tr>
<th>Score</th>
<th>Level of ability</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 34</td>
<td>0% – 34%</td>
<td>Very Low</td>
</tr>
<tr>
<td>35 – 54</td>
<td>35% – 54%</td>
<td>Low</td>
</tr>
<tr>
<td>55 – 64</td>
<td>55% – 64%</td>
<td>Medium</td>
</tr>
<tr>
<td>65 – 84</td>
<td>65% – 84%</td>
<td>High</td>
</tr>
<tr>
<td>85 – 100</td>
<td>85% – 100%</td>
<td>Very High</td>
</tr>
</tbody>
</table>

Mathematical communication ability test questions and indicators of mathematical communication ability are shown in Table 3.

Table 3. Indicators and questions test of mathematical communication ability

<table>
<thead>
<tr>
<th>Indicators of mathematical communication</th>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Express real objects, situations, and everyday events into mathematical models (pictures, tables, diagrams, graphs, algebraic expressions); Explain mathematical ideas and models (pictures, tables, diagrams, graphs, algebraic expressions) and solve them</td>
<td>1. Given the perimeter of the triangle PQR 70 cm. The PR length is 2 cm more than the PQ length. QR length is 6 cm less than PR length. If x represents the length of PQ, y represents the length of QR, and z represents the length of PR. a. Create a mathematical model for the side-length relationships of triangle ABC. b. Calculate how long each side of triangle ABC is.</td>
</tr>
<tr>
<td>Expressing real objects, situations, and everyday events in the form of mathematical models (pictures, tables, diagrams, graphs, algebraic expressions); Declare everyday events in language or mathematical symbols and solve them</td>
<td>2. An isolated metal rod with a temperature at each point is indicated by t₁, t₂, t₃, as shown in the figure. If the temperature at the designated points is equal to the average of the two temperatures at the nearest point, what is the temperature at t₁? Arrange a proper mathematical model and solve the problem.</td>
</tr>
</tbody>
</table>
Stating situations of everyday events into tabular form, constructing mathematical models of problems and solving them.

3. Pak Arief has three hectares of rice fields planted with rice, and it is time for fertilizer. Three types of fertilizers must be provided, namely Urea, SS, TSP. Farmers must use these three types of fertilizers for maximum rice yields. The price for each bag of fertilizer is 60,000 IDR; 125,000 IDR; and 145,000 IDR. Pak Arief needs as many as 60 sacks for rice fields planted with rice. The use of SS fertilizer is three times as much as TSP fertilizer. Meanwhile, the funds provided by Pak Arief to buy fertilizer is 5,000,000 IDR. How many sacks for each type of fertilizer should Mr. Arief buy?

3 Result and Discussion

The data obtained in this study came from tests of mathematical communication ability, mathematical resilience questionnaires, which were distributed online, and also interviews via Zoom. Based on the study that has been done, the seven students' mathematical resilience categories can be seen in Table 4.

Table 4. The Result of Mathematical Resilience Questionnaires

<table>
<thead>
<tr>
<th>Mathematical Resilience Categories</th>
<th>Students’ Codes</th>
<th>Number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>S1, S4, S7</td>
<td>3</td>
</tr>
<tr>
<td>Medium</td>
<td>S2, S3</td>
<td>2</td>
</tr>
<tr>
<td>Low</td>
<td>S5, S6</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 4 shows that of the seven students, two students have low mathematical resilience, and three have high mathematical resilience. Furthermore, the students' mathematical resilience data were compared with the students' mathematical communication ability test results.

Table 5. The Result of Mathematical Communication Ability Based on Resilience Category

<table>
<thead>
<tr>
<th>Resilience Category</th>
<th>Students’ Codes</th>
<th>Mathematical Communication Score</th>
<th>Percentage of Mathematical Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>S1</td>
<td>80</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>S4</td>
<td>75</td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td>S7</td>
<td>85</td>
<td>85%</td>
</tr>
<tr>
<td>Medium</td>
<td>S2</td>
<td>60</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td>S3</td>
<td>50</td>
<td>50%</td>
</tr>
<tr>
<td>Low</td>
<td>S5</td>
<td>40</td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td>S6</td>
<td>25</td>
<td>25%</td>
</tr>
</tbody>
</table>

Table 5 shows that S1, S4, and S7, who have high mathematical resilience, are in the same category in mathematical communication ability, with the respective percentages being 80%, 75%, and 85%. S1 and S2 students are in the 65%-84% interval with the high category, and S3 are at the 85%-100% interval with the category of very high mathematical communication ability; S2 has moderate mathematical resilience and is in the same category as their mathematical communication ability which is in the moderate category with a percentage of
60%. Meanwhile, S3 has moderate mathematical resilience, but the ability to communicate mathematics is low, with a percentage of 50%. S5 and S6 both have low mathematical resilience and low mathematical communication capabilities. However, S6's mathematical communication ability is lower than S5, with a communication ability percentage of 25%.

Table 5 shows that students with high mathematical resilience obtain high and very high scores of mathematical communication ability. Meanwhile, students with low mathematical resilience obtain low and very low scores of communication ability.

Figure 2 shows that students (S4) with high mathematical resilience can express problems/ideas in the form of images, state situations in a mathematical model, explain the relationship between variables well and solve problems. In Figure 3, students (S6) with low mathematical resilience cannot explain their answers well in a mathematical model. The answers they give are correct but not systematic; language delivery in mathematical ideas and mathematical symbols still has many shortcomings. Whereas in Figure 4, the student's (S3) answer with moderate resilience is right; he can state the situation in the form of a mathematical model and solve it well.
Figures 5, 6, 7 show the answers to the second problem solving of each student with moderate (S2), low (S5), and high (S4) mathematical resilience. Figure 5 shows that students with moderate mathematical resilience (S2) can state an event in the form of a mathematical model even though the procedure in progress and the answer is not correct. Not much different from S2 students, in Figure 6, students with low mathematical resilience (S5) can express an event in the form of a mathematical model but cannot solve it well. Both students' answers were wrong in their solution. Although they can write problems into a mathematical model, there are errors in explaining mathematical relationships verbally in written form. Whereas in Figure 7, students with high mathematical resilience (S4) students can express problems into mathematical ideas with correct and systematic procedures. S4 students can explain and make relationships between variables in mathematical models and can solve problems appropriately and correctly.

Based on the student interview results after working on the questions and filling out the mathematical resilience questionnaire, they said that their working on it was quite tricky. The difficulties they experienced in learning mathematics during the Covid-19 pandemic included that sometimes the teacher provided exercises or question material that was different from the assignment questions given, so the assignments given were not the same as the exercises are done.
4 Conclusion

Based on the results and discussion above, the study shows that high resilience students also have high mathematical communication ability. Some students could not solve the test questions well, but several others proved that they had good mathematical communication ability with high mathematical resilience. According to students, the Covid-19 pandemic is quite an obstacle for those who have low mathematical resilience. This is due to several factors, including the limited time to ask the teacher, the difficulty of communicating with other friends, they are not used to speaking or giving opinions in front of friends or teachers, a sense of self-doubt, and lack of learning ability because they feel they are not in the same class state. So that it can affect students' mathematical communication ability, however, from the results of the study, it can be concluded that students' mathematical communication ability is quite good when viewed from the mathematical resilience during the Covid-19 pandemic, even though there are some difficulties they experience.

Acknowledgment. Thank you to the seven students who participated in this study to be carried out.

References

[12] Sumarmo U. Pendidikan karakter serta pengembangan berfikir dan disposisi matematik dalam
Extract of Bitter Melon (Momordica Charantia L.) as a Cytotoxic and Anti Proliferation Agent for Cells WiDr (Colon Cancer)

Eka Yulianti¹, Sutyarso², Hendri Busman³, Nuning Nurcahyan⁴, Sri Wahyuningsih⁵
{ekayuliantibe@gmail.com¹, sutyarso@yahoo.co.id², hendri_99@yahoo.com³, nuning.nurcahyan@fmipa.unila.ac.id⁴, and wahyu6125@yahoo.co.id⁵}

Master student of Biology, Faculty of Mathematics and Natural Sciences, Universitas Lampung, Jl. Prof. Dr. Soemantri Brojonegoro No.1, Bandar Lampung, 35145 Indonesia¹
Master in Biology Program, Faculty of Mathematics and Natural Sciences, Universitas Lampung, Jl. Prof. Dr. Soemantri Brojonegoro No.1, Bandar Lampung, 35145 Indonesia²,³,⁴,⁵

Abstract. Colon cancer is one of the types of cancer that gives a high mortality rate. Many people with colon cancer do not realize they have colon cancer because the initial spread does not show severe symptoms. Colon cancer occurs due to cell abnormalities caused by DNA mutations. To reduce the death rate caused by cancer, there have been many attempts to find effective treatments, both modern and traditional. Modern treatments such as surgery and chemotherapy still often have adverse effects on sufferers. Therefore, new efforts are made to find alternative treatments, one of which is the traditional way of exploring natural ingredients and utilizing secondary metabolites produced by plants. Pare (Momordica charantia L.) is an anticancer candidate characterized by the presence of cytotoxic saponins momordicosides, flavonoids, and alkaloids as inhibitors of cell development processes. This study’s objectives were (1) To determine the cytotoxic effect of bitter melon (M. charantia L.) extract on reducing the number of colon cancer cells (WiDr), (2) To determine the effect of the proliferation of bitter melon (M. charantia L.) extract on reducing the number of colon cancer cells (WiDr). The results obtained for the cytotoxic test, namely the IC₅₀ value of 111 µg / ml, were said to have quite toxic properties and were able to have anticancer activity. The proliferation test showed that EBP inhibited the proliferation rate at the 24-hour incubation period and had time to increase at a concentration of 13,875 µg / ml with values above 400 hours.

Keywords: Colon Cancer, Cytotoxic, Momordica charantia L., Proliferation.

1 Introduction

Cancer, also known as a malignant neoplasm, is a disease characterized by cell cycle abnormalities that cause cells’ ability to grow out of control [1]. Colon (colorectal) cancer is one of the most common causes of death in the world, with America an estimated incidence of 75,610 cases in men and 64,640 cases in women with an overall average of about 80,000 deaths per year [2] while for Indonesia, colon cancer includes ten primary cancers are common [3].
Colon cancer, which grows on the surface of the colon (intestine) or rectum (anus), which is part of the large intestine in the digestive system, is also called the gastrointestinal tract, which functions as a producer of energy for the body and removes waste products that are not useful [4]. Today, medical practitioners generally have three ways of treating cancer, namely surgery, radiation, and chemotherapy [5].

Surgery is an invasive treatment procedure through incisions to open or reveal parts of the body that will help generally experience a high increase in cancer cells that have not metastasized (spread), the effects of surgery failure can cause cancer to spread to other body tissues and worsen the condition. Radiotherapy, which uses radioactivity to destroy tumor cells. The advantage is that it only causes minor damage to the surrounding normal tissue. The types of radiation rays commonly used are gamma rays (γ) and X-rays [6].

Chemotherapy is a treatment effort to kill cancer cells by giving synthetic chemotherapy drugs, unlike surgery or radiation locally, chemotherapy is spread throughout the body because it is a systemic therapy, which means the drugs given spread throughout the body. So that the resulting effect will make sufferers experience anemia, thrombocytopenia, leucopenia, nausea, vomiting, alopecia, stomatitis, allergies, pain and tissue necrosis [7].

Bitter melon has a bitter taste caused by the content of momordicosides of the triterpene glucoside group or kukurbitasin which are very patent antiproliferative and anti-differentiation properties. Efforts to develop alternative preparations in traditional medicine that can replace synthetic chemotherapy drugs and are relatively more effective in increasing body immunity. Traditional medicine that is often used comes from natural ingredients, namely plants, by knowing secondary metabolite compounds' content.

bitter melon contains saponins and is cytotoxic. Cytotoxics are substances or compounds that can damage cancer cells. Flavonoids inhibit a number of cell development processes in the body through inhibition of a number of enzymatic reactions as well as potential anti-cancer drugs. The United States NCI (National Cancer Institute) states that an extract or compound can be said to be potential as an anticancer agent if it has an IC value of <50 µg / ml and if an extract or compound has an IC value of > 140 µg / ml then the extract or compound is said to be not. It is toxic and has no anticancer activity [8]. Proliferation inhibition activity can occur due to alkaloid and flavonoid compounds in the bitter melon extract that can stimulate enzymes to inhibit the cell cycle, as an antiproliferation and angiogenesis of cancer cells [9]. The mechanism for inhibiting proliferation occurs probably because cells die. This cell death can go through the cell cycle mechanism to stop (arrest) by stopping the cell cycle, so the cells cannot reproduce themselves.

2 Method

2.1. Material

The material used in this research was bitter melon, 96% ethanol, cell culture for cytotoxic and proliferation test: culture media in the form of Roswell Park Memorial Institute (RPMI), phosphate buffer saline (PBS), solvent methanol, dimethyl sulfoxide (DMSO), propidium iodide, trypsin EDTA, microtetrazolium (MTT), sodium dodecyl sulfate (SDS) 10%, ethidium bromide-acridine orange.

2.2. Equipment

Include a set of extraction tools in the form of a cutting knife, plastic tub/trough, oven, mortar, Buchner, funnel and filter paper, rotatory evaporator. The cytotoxic and proliferation
test kits for colon cancer cells are liquid nitrogen tank, water bath, laminar airflow, refrigerator, Eppendorf tube, centrifuge tube, centrifugation, micropipette 10, 20, 200, and 1000µL, small test tube, six and 96-well plate, conical tube, yellow tip and blue tip, Elisa reader, vortex, coverslip, hemocytometer, CO2 incubator, the waste container for used media for phosphate buffer saline (PBS), tissue, aluminum foil, fluorescence microscope.

2.3. Research Implementation
This research consists of several stages, namely 1). Sample preparation ; 2). WiDr cell cytotoxic test (Microtetrazolium method); and 3). WiDr cell proliferation test (Doubling time Method). This research stage is presented in figure 1.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Indicator</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Preparation</td>
<td>Has a like pasta texture.</td>
<td>I am lost of EBP pasta for stock.</td>
</tr>
<tr>
<td>Cytotoxic Test</td>
<td>WiDr cells are unable to survive due to the addition of the toxic compound EBP.</td>
<td>The decrease in the number of WiDr cells.</td>
</tr>
<tr>
<td>Proliferation Test</td>
<td>WiDr cells experience slow growth (inhibited) by compounds from EBP.</td>
<td>The decrease in the number of WiDr cells.</td>
</tr>
</tbody>
</table>

Figure 1. Research Implementation

3 Result and Discussion
The results obtained for cytotoxic were the highest average absorbance of living cells after being given EBP at a sample concentration of 50µg/ml with a value of 101.0737%. The lowest was at a concentration of 275µg/ml with a value of 0.572656%. With an increase in EBP concentration, it can have a cytotoxic effect on WiDr cells so that the number of WiDr cells decreases; however, based on the data in Table 1, the average percentage of living cells gives varied results, even at the highest concentration of 300µg/ml EBP gives the value of % living cells of 2.791696 which is lower than the percentage of living cells at the concentration below.

It is assumed that too high a concentration is not too good and can result in cells having higher adaptability. To determine how toxic a substance or extract is, it is necessary to calculate the IC_{50} value. IC_{50} can be seen directly from the number 50 on the percentage results of the ability to live cells. The number 50% of living cells fall into the concentration range between 125µg/ml to 100µg/ml. The IC_{50} value obtained was 111 µg/ml. These results are used for the proliferation test.

<table>
<thead>
<tr>
<th>Concentration (µg/mL)</th>
<th>Absorbance EBP</th>
<th>Mean % Live Cell</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P1</td>
<td>P2</td>
<td>P3</td>
</tr>
<tr>
<td>300</td>
<td>0.143</td>
<td>0.137</td>
<td>0.140</td>
</tr>
<tr>
<td>275</td>
<td>0.137</td>
<td>0.126</td>
<td>0.126</td>
</tr>
</tbody>
</table>
Based on the data above, EBP has an IC value of <150 µg / ml, and it can be said that EBP is categorized as quite toxic and has anticancer activity. This is evidenced by the research [10] that the IC50 value <150 µg / ml is categorized as quite toxic and has a positive correlation as an anticancer agent. The United States NCI (National Cancer Institute) states that an extract or compound can be said to be potential as an anticancer agent if it has an IC value of <50 µg / ml and if an extract or compound has an IC value of >140 µg / ml then the extract or compound is said to be not. It is toxic and has no anticancer activity [8]. The chemical content of unripe bitter melon fruit, which has medicinal properties, is saponins, flavonoids, alkaloids, polyphenols [11], and cucurbitacin glycosides, charantin, butyric acid, steroid compounds, monocyclic alcohol, and some triterpenoid compounds [12]. This is following the latest research conducted by[13], which states that the ethyl acetate fraction of 70% ethanol extract from bitter melon has high toxicity properties to HeLa cells with an incubation period carried out within 24 hours and 48 hours of the ethyl acetate fraction from ethanol extract 70% incubation 24 and 48 hours amounted to 34,9221 and 22,1871 µg/ml.

![Figure 2. Diagram of the Doubling Time of WiDr Cell Proliferation](image)

The results of the proliferation test using the Doubling Time method can be seen in Figure 2. It proved that the adequate concentration time to inhibit cell growth is in the 24-hour incubation period. This is following that at 24 hours, and there is a decrease in the number of living cells. The highest doubling time value, namely at a concentration of 1 / 8IC50 or 13,875 µg/ml, had a length of time for cells to divide into two times the initial time at each incubation
time of 400 hours. Meanwhile, the concentration of 2IC$_{50}$ or 222 µg/ml has a shorter doubling time than other concentrations, which is at 100 hours. This can be caused by cell death. This cell death can go through the cell cycle mechanism to stop (arrest) by stopping the cell cycle, so the cell cannot reproduce itself.

Proliferation inhibition activity can occur due to the presence of alkaloid and flavonoid class compounds contained in bitter melon fruit extract, as stated by [14] that the positive bitter melon contains secondary metabolite compounds, namely flavonoids. Flavonoids can stimulate enzymes to inhibit the cell cycle as an antiproliferation and angiogenesis of cancer cells [7]. The mechanism for inhibiting proliferation occurs probably because cells die. This cell death can go through the cell cycle mechanism to stop (arrest) by stopping the cell cycle, so the cell cannot reproduce itself. According to [15], proliferation inhibition can also occur through the formation of DNA fragmentation, decreased Bcl mRNA expression, and increased Bax mRNA expression.

4 Conclusion

Conclusions that can be drawn from the research conducted bitter melon fruit are: (1) the cytotoxic effect of bitter melon extract can reduce the number of colon cancer cells (WiDr). Bitter melon are toxic to colon cancer cells WiDr, for the cytotoxic test, namely the IC$_{50}$ value of 111 µg / ml, was said to have quite toxic properties and were able to have anticancer activity. (2) The proliferative effect of bitter melon extract can inhibit proliferative activity and reduce the number of colon cancer cells (WiDr). The bitter melon fruit extract can also reduce the growth of colon cancer cells WiDr by reducing the rate of cell proliferation. The proliferation test showed that EBP inhibited the proliferation rate at the 24-hour incubation period and had time to increase at a concentration of 13,875 µg / ml with values above 400 hours.

Acknowledgments. Researchers want to thank the University of Lampung and Gadjah Mada University Yogyakarta for supporting this research.

References


Estimation of The Effect Size Meta Measurement Model with Generalized Method of Moments Approach

Hary Suprihanto¹, Bambang Widjanarko Otok², Agus Suharsono³
{hary.bma@gmail.com¹, bambang_wo@statistika.its.ac.id², dr.otok.bw@gmail.com³, gmagussuharsono@gmail.com³}

Department of Statistics, Faculty of Science and Data Analytics, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia¹,²,³

Abstract. Generalization of research results often cannot be made using only one finding, so a synthesis of several research results is needed to obtain an integrated conclusion. The synthesis of several research results through meta-analysis has developed in the study of Structural Equational Modeling (SEM), one of which is the measurement model. The aim of this study is to obtain an estimate of the effect size of the meta-analysis measurement model on the factors that measure the performance of regional drinking water companies. The data used is the performance data of regional drinking water companies in Java. The company's performance is measured based on four main criteria: financial, service, operational, and human resources. Measurement modeling and meta-analysis were carried out using software R. The estimation method used is the Generalized Method of Moments (GMM). The results of this analysis show that the model for performance assessment is a fit model. The model developed meets the requirements for the quality of the fit model, thereby confirming that financial, service, operational, and human resource indicators can be used to measure regional drinking water companies' performance in Java. Besides, through the combined effect size estimation, it can be concluded that human resource and finance is the most dominant indicator in measuring company performance.

Keywords: Effect Size, Meta-Anaysis, Measurement Model, GMM

1 Introduction

In various applications in statistics, meta-analysis is very useful for synthesizing information about general parameters that underlie interest in various studies [1]. The advantage of meta-analysis is that it can be done solely on the basis of model parameter estimation and standard errors. It can be found that parameter estimates from this analysis are asymptotically efficient under rational assumptions as those from the combined analysis [2]. Furthermore, in its development, meta-analysis can also be carried out in the discussion of structural equational modelling, which includes regression analysis, path analysis, and confirmatory factor analysis (CFA) [3]. The measurement error of a variable is a severe problem in structural model analysis. This results in a lack of construct validity when building a model and weak parameter estimates involving multiple constructs in the structural model [4]. An analysis is needed, namely CFA, to identify latent factors that explain variations and covariances between indicators [5]. The theoretical justification is an absolute requirement in SEM. On the other side, concerning CFA, there are often differences in measuring a variable in theory.
Further analysis is needed to determine the accuracy of variable measurement through Meta-Confirmatory Factor Analysis (Meta-CFA). Meta-CFA is a combination of two methods: meta-analysis and CFA, which only considers the measurement model and can be considered a particular case in meta-analysis structural equation modelling (MASEM) [6]. Meta-CFA is based on the unifying correlation matrices between units from a number of research units, which are then used as input for CFA to evaluate a number of factor model structures [7]. Meta-CFA can be more advantageous than traditional statistical approaches, as it allows several samples, conditions and measurements to be tested for the model [8]. Several studies on Meta-CFA have been conducted, some of which are evaluation of structure of the Hospital Anxiety and Depression Scale (HADS) anxiety variables [9], inconsistencies in measuring personality variables using the big five traits indicator [10], and the ambiguity of measuring the variable Figural Torrance Tests of Creative Thinking [11].

Research on Meta-CFA related to the assessment of organizational performance measurement models is very rare. This is because the organizational performance model is usually a standard model that is not evaluated in a short period of time. Evaluation of quality standards and performance services of regional drinking water companies in Java Indonesia is an activity of assessing and measuring each aspect of performance appraisal so that it can be seen the quality and achievements in providing drinking water supply services to the community. The performance evaluation indicators of regional water companies currently used are the result of development in 2010. The performance indicators consist of four aspects: finance, services, operations, and human resources. On the other side, the differences in the regional drinking water companies' characteristics in each city often result in different measurements. The difference in performance measurement is interesting to study to determine the best performance measurement model.

The performance aspects of regional drinking water companies cannot be measured directly, but through known indicators, in such a way that the appropriate statistical analysis is Meta-CFA. The results of previous research on the performance of regional drinking water companies in Java are minimal, so that it is not possible to obtain a correlation matrix which is the input of Meta-CFA, so in this study, it is assumed that Meta-CFA on the factors that measure the performance of regional drinking water companies in Java as a result of annual research begins from 2010 to 2018. The research results in each period of the year can produce different conclusions so that in this study, a Meta-CFA will be conducted on the factors that measure the performance of regional drinking water companies in Java.

2 Method

The data used in this analysis are secondary data in the form of publications on the performance data of regional drinking water companies in Java for the period 2010-2018, which is the result of annual data processing organized by the agency to improve the implementation of the drinking water supply system. The observation unit in performance measurement is annual research from 2010 to 2018. The CFA modeling results from the subsequent annual research are used as a unit of analysis in meta-analysis with the GMM approach to define factors that assess the performance of regional drinking water companies in Java.

This study uses eight indicators that measure the performance of regional drinking water companies in Java. Based on technical guidelines for evaluation of performance indicators by
the agency of drinking water supply system in 2010, the indicator variables used in this study are as follows:

1. Finance ($X_1$)
   - Operating Ratio: Ratio to measure the level of efficiency of expenses incurred to generate income
   - Billing Effectiveness: Percentage of the effectiveness of collection activities on the proceeds from sales of water
   - Solvency: A measure of the company's ability to guarantee long-term liabilities with its assets

2. Services ($X_2$)
   - Technical Service Coverage: Percentage of total population served by the company compared to the population in the service area
   - Customer Complaint Settlement: Measure to assess the company's response to customer complaints

3. Operations ($X_3$)
   - Production Efficiency: Production utilization factor to measure the efficiency of the production system
   - Water Loss Rate: The difference between the water entering the distribution unit and billed water during the evaluation period

4. Human Resources ($X_4$)
   - Employee to Customer Ratio: the level of efficiency and effectiveness of the use of labor to provide services to customers

The observation unit used in this study is the correlation matrix of the CFA modeling results of the factors that affect regional water companies’ performance in Java. The indicator variable in CFA modeling in this study is a latent variable with formative measurements. To obtain a correlation matrix in each research year using the factor score weights from the SmartPLS 3.0 program results multiplied by each indicator's data. Factor score derives from latent variables, both endogenous and exogenous, in the measurement model [12]. The steps taken to answer the research objectives using the Meta-CFA method on the factors that measure the performance of regional drinking water companies in Java are as follows:

1. Determine the value of the factor score weights on each CFA indicator variable (Finance, Services, Operations, Human Resources) using the SmartPLS 3.0 program for each year.
2. Calculation of the vector score factor indicator (Finance, Services, Operations, Human Resources) with the formula:
   \[ FS = X_n^p W_{pi} \]
   FS: Factor Score
   X: Indicator Data
   W: Weights
   Furthermore, the value obtained in this step becomes the CFA modeling data each year.
3. Conduct CFA modeling on the factors that measure company performance every year from 2010 to 2018 with the following conceptual model:
4. Develop a correlation matrix for each year.
5. Conduct a homogeneity test on the research correlation matrices.
6. Calculate the combined correlation matrix with fixed effects in homogeneous cases or random effects in heterogeneous cases.
7. Use the combined correlation matrix as input in the next step.
8. Perform a model fit test.

3 Results and Discussion

The correlation matrix produced in step 3 is the effect size generated in each year. Table 1 below presents the effect size results from nine annual studies:

<table>
<thead>
<tr>
<th>Year</th>
<th>n</th>
<th>X_1</th>
<th>X_2</th>
<th>X_3</th>
<th>X_4</th>
<th>X_5</th>
<th>X_6</th>
<th>X_7</th>
<th>X_8</th>
<th>X_9</th>
<th>X_10</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>107</td>
<td></td>
<td>0.191</td>
<td>0.198</td>
<td>0.191</td>
<td>-</td>
<td>-</td>
<td>0.237</td>
<td>-</td>
<td>0.361</td>
<td>-</td>
</tr>
<tr>
<td>2011</td>
<td>107</td>
<td></td>
<td>0.043</td>
<td>0.051</td>
<td>0.086</td>
<td>-</td>
<td>-</td>
<td>0.237</td>
<td>-</td>
<td>0.450</td>
<td>0.433</td>
</tr>
<tr>
<td>2012</td>
<td>107</td>
<td></td>
<td>0.042</td>
<td>0.046</td>
<td>0.070</td>
<td>-</td>
<td>-</td>
<td>0.272</td>
<td>-</td>
<td>0.471</td>
<td>0.398</td>
</tr>
<tr>
<td>2013</td>
<td>107</td>
<td></td>
<td>0.201</td>
<td>0.357</td>
<td>0.201</td>
<td>0.221</td>
<td>-</td>
<td>0.486</td>
<td>0.221</td>
<td>0.533</td>
<td>0.486</td>
</tr>
<tr>
<td>2014</td>
<td>107</td>
<td></td>
<td>0.060</td>
<td>0.083</td>
<td>0.099</td>
<td>0.060</td>
<td>0.083</td>
<td>0.333</td>
<td>0.397</td>
<td>0.333</td>
<td>0.552</td>
</tr>
<tr>
<td>2015</td>
<td>107</td>
<td></td>
<td>0.119</td>
<td>0.023</td>
<td>0.023</td>
<td>0.119</td>
<td>-</td>
<td>0.003</td>
<td>-</td>
<td>-</td>
<td>0.023</td>
</tr>
<tr>
<td>2016</td>
<td>107</td>
<td></td>
<td>0.099</td>
<td>0.012</td>
<td>0.012</td>
<td>0.099</td>
<td>-</td>
<td>0.012</td>
<td>0.002</td>
<td>-</td>
<td>0.552</td>
</tr>
<tr>
<td>2017</td>
<td>107</td>
<td></td>
<td>0.022</td>
<td>0.031</td>
<td>0.053</td>
<td>0.022</td>
<td>0.012</td>
<td>0.003</td>
<td>-</td>
<td>0.232</td>
<td>0.552</td>
</tr>
<tr>
<td>2018</td>
<td>107</td>
<td></td>
<td>0.137</td>
<td>0.084</td>
<td>0.023</td>
<td>0.137</td>
<td>0.043</td>
<td>0.003</td>
<td>0.012</td>
<td>0.002</td>
<td>0.003</td>
</tr>
</tbody>
</table>

Table 1 shows that the resulting effect sizes vary widely, for example in 2010 the largest effect size with a positive value (0.361) lies in the relationship between finance and human
resources, while in 2011 the largest positive effect size (0.237) lies in the relationship between services and operations. Likewise, in the following years, the analysis results were relatively different. This effect size variation underlies further analysis to obtain a combined effect size.

Two-Stage Structural Equational Modelling (TSSEM) approach with GMM estimation has two steps of analysis: testing the homogeneity which results in the estimated effect size of the combined correlation matrix and the model suitability test from the combined effect size estimation results. The model homogeneity test results obtained Q-statistic of effect sizes 946.9391 and p-value <0.001, so it is a TSSEM random effect model. The resulting combined correlation matrix is:

\[
R_{ pooled} = \begin{bmatrix}
\text{Performance} & \text{Human Resources} & \text{Operations} & \text{Services} & \text{Finance} \\
\text{Performance} & 1 & 0.591 & -0.112 & -0.303 & 0.460 \\
\text{Human Resources} & 0.591 & 1 & -0.089 & -0.280 & 0.113 \\
\text{Operations} & -0.112 & -0.089 & 1 & 0.054 & -0.057 \\
\text{Services} & -0.303 & -0.280 & 0.054 & 1 & -0.049 \\
\text{Finance} & 0.460 & 0.113 & -0.057 & -0.049 & 1 \\
\end{bmatrix}
\]

The combined effect size clarifies the results of the meta analysis. The resulting matrix shows that human resources and finance each have the strongest relationship with performance with a correlation of 0.591 and 0.460, while operations and services have a relatively low correlation.

The following table is the estimated value of the loading factor for each indicator against the latent variable:

| Indicator      | Estimate  | Std.Error  | z value | P>|z|)   |
|----------------|-----------|------------|---------|-------|
| Human Resources| 7.4314e-01| 8.7985e-02| 8.4462  | <2.2e-16 *** |
| Operations     | 6.0122e-09| 3.3160e-01| 0.0000  | 1     |
| Services       | -6.8756e-10| 9.1805e-02| 0.0000  | 1     |
| Finance        | 6.5394e-01| 1.0519e-01| 6.2166  | 5.082e-10 *** |

It can be seen from Table 2 that human resources and finance can measure the performance variable well. This is indicated by the resulting p-value <0.001, while the operations and services indicator shows an invalid measurement. In addition, based on Godness of Fit Indices, RMSEA value is ≤0.08, implying that the model has verified the measurement of performance variables.

### 4 Conclusion

The conclusion that can be drawn from the results of the analysis is that the resulting Meta-CFA model is fit and can be used to explain the performance of regional drinking water companies in Java. The resulting combined effect size value shows that the human resource and financial indicators are the indicators with the highest measurement contribution to performance, while the other two indicators, namely the operational and service indicators, show a weak measurement contribution.
References

Imbalanced Data Analysis of Adolescent Risk Behavior of Drug Abuse using Random Forest

Imaini Zain1*, Kartika Fithiasari2, Erma Oktania Permatasari3, Tyas Ajeng Nastiti4, Mardyono5, Nilam Novita Sari6, Resti Pujihasvuty7, Sri Lilestina Nasution8

{ismaini_z@statistika.its.ac.id1*, kartika_f@statistika.its.ac.id2, erma.oktania@gmail.com3}

Department of Statistics, Faculty of Science and Data Analystics, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia1,2,3,6, Department of Visual Communication Design, Universitas International Semen Indonesia, Gresik, Indonesia4, National Population and Family Planning Board, East Java, Indonesia5

Abstract. Adolescence represents a period of self-searching and vulnerability to fall into risky behavior such as drug abuse. In Indonesia, the case of drug abuse by adolescents is high. Therefore, to know the factors behind it can be done using classification such as random forest. The data used in this research were adolescent risk behavior of drug abuse based on SKAP. The percentage of drug abuse among adolescents are 4.1% shows that there is an imbalanced class in the data. It is necessary to handle the imbalanced data by applying the SMOTE-N. This study will classify the adolescent risk behavior of drug abuse using random forest combine with SMOTE-N to handle the imbalanced class. The results show that the model using SMOTE-N is better because it can increase specificity and g-means. The variables affect the classification of drug abuse among adolescents are the age, sex, and psychology consequence.

Keywords: Adolescent Risk Behavior, Drug Abuse, Imbalanced Data, Random Forest, SMOTE-N

1 Introduction

Adolescence is when an individual is no longer a child but has not yet become an adult. During this time, an individual begins to experience physical and psychological changes internally while also changing social expectations and perceptions. Adolescence is a period of self-searching. In this period, they are beginning to experience changes in lifestyle and relationships. At this time, adolescents are vulnerable to being influenced by their surroundings. The wrong surrounding can cause teenagers to fall into risky behavior. Risky behavior is defined as any conscious or non-conscious behavior with adverse social effects, such as drug abuse [1,2].

Drug abuse refers to the usage of drugs in excessive quantities or for purposes for which it was not intended, leading to significant distress, allowing the person to suffer from tolerance [3]. Different drugs can be abused, including illegal drugs such as heroin, prescription medicines like pain killers, and other medicines that can be bought off the supermarket, such as cough mixers [3]. Three factors affect adolescent risk behavior. First is the predisposing or motivating factors coming from the individual such as knowledge, age, gender, education, etc. The second is the enabling factor that allows or encourages such behavior to be carried out,
such as health resources, economic status, access to information media, domicile location (urban or rural), etc.

The last is the reinforcing factor determined by other people, including family, friends, teachers, etc. The consequent reasons for drug abuse among adolescents are the absence of communication between parents and children, ease of access to drugs, depression, socialization problems, experimentation, peer pressure, confidence problems, etc. [4]. In 2015, [5] discuss about the factors affect the adolescent drug abuse behavior and the results show that ease of access to drugs and friends are the factors affect the drug abuse behavior. Knowledge and attitudes on drug abuse have been discussing by [6], with the results showing that the higher the adolescents’ knowledge, the fewer adolescents will be involved in drug abuse. The lack of the knowledge of the drug

The lower the adolescents’ knowledge, the higher adolescents will be involved in drug abuse and it can cause the number of drug abuse will increase. In Indonesia, in 2017, the number of people between 10 and 59 who abused drugs is about 3.37 million. Meanwhile, the number of students who abused drugs in 2018 is 2.29 million. The age range of 15-35 years old is the group that is prone to drug abuse [7]. Based on SKAP, in East Java in 2019, the number of adolescents who consume drugs is 191 or 4.1%. Although the number of adolescents who consume drugs is small, but it will have negative impact. Therefore, analysis is needed to investigate the factors behind it. Classification can be used to find out the factors to predict adolescent risk behavior of drug consumption.

Classification is the process of finding a model that describes data classes, and the model is used to predict the class label of objects for which the class label is unknown [8]. One of the popular classification methods is a tree-based classification, of which Random forest is one of them. A random forest is a collection of decision trees. The individual decision trees are generated using a random selection of attributes at each node to determine the split. During the classification, each tree votes, and the most popular class is returned [8]. Random forest is appealing because of the additional features they provide, such as measuring variable importance [9]. The variable importance is used to measure the candidate predictor variables that most influence is predicting the response variable. MDG (Mean Decrease Gini) is one of the essential measures. MDG calculated by adding up all the node impurity (Gini index for classification) decrease from splitting variable and then averaged over all the trees [10]. Apart from measuring variable importance, random forest also computes the missing value, detect outliers, give class weighting, etc. [8].

Although random forest has many advantages and provides additional features, if working on imbalanced data, the random forest will produce a higher accuracy for the majority class than for the minority class. The percentage of an adolescent who consumed drugs is lower than not consume the drug. This condition shows the class imbalance in the data. Imbalanced data is a condition where one of the classes (majority class) contains a much larger number of data than the other classes (minority class) [11].

The imbalanced classes can cause a bias in the majority classes because the data from the minority class tend to be misclassified [11]. Several methods have been proposed to learn from imbalanced data. The data-level approach or resampling methods are the most popular approach to handle imbalanced data [11]. It generates new training datasets to make the class distribution more balanced [12]. Data-level approaches They are divided into over-sampling, under-sampling, and hybrids sampling. SMOTE is one of the most popular over-sampling methods that overcome random over-sampling [13]. It does this by creating “synthetic” data rather than over-sampling with replacement in the minority class. While SMOTE is used for numeric datasets, SMOTE-N is used to handle datasets with nominal features [13]. The
The classification of imbalanced data using SMOTE-N and logistic regression was done by [14]. The results show that the model using SMOTE-N has the highest AUC than the model without SMOTE-N, which means that SMOTE-N can increase the model's accuracy.

This study aims to classify imbalanced data on adolescent risk behavior of drug abuse using random forest and combined with SMOTE-N to handle the imbalanced classes in the data, which can help identify the factors that affect adolescent risk behavior of drug abuse.

2 Methods

2.1 Data

The data used in this research were the adolescent risk behaviors based on SKAP (Survei Kinerja dan Akuntabilitas Program KKBPK) of East Java in 2019 by BKKBN.

2.2 Research Variables

The variables used in this research are as follows:

\[ Y = \text{drug consumption} \ (0 = \text{No}, 1 = \text{Yes}) \]
\[ X_1 = \text{age} \ (0 = < 19 \text{ years old}, 1 = \geq 19 \text{ years old}) \]
\[ X_2 = \text{sex} \ (0 = \text{Male}, 1 = \text{Female}) \]
\[ X_3 = \text{education} \ (0 = \text{did not go to school or has completed either elementary or junior high school}, 1 = \text{completed either senior high school or college education}) \]
\[ X_4 = \text{domicile} \ (0 = \text{urban}, 1 = \text{rural}) \]
\[ X_5 = \text{knowledge of drugs} \ (0 = \text{no}, 1 = \text{yes}) \]
\[ X_6 = \text{knowledge of the physical consequences of the drug} \ (0 = \text{no}, 1 = \text{yes}) \]
\[ X_7 = \text{knowledge of the psychological consequences of the drug} \ (0 = \text{no}, 1 = \text{yes}) \]
\[ X_8 = \text{knowledge of the socioeconomic consequences of the drug} \ (0 = \text{no}, 1 = \text{yes}) \]
\[ X_9 = \text{knowledge of adolescent sexual and reproductive health (ASRH)} \ (0 = \text{no}, 1 = \text{yes}) \]

2.2 Research Design

The classification process for imbalanced data of adolescent risk behavior of drug abuse starts with partitioning the adolescent risk behavior of drug abuse into training and testing data using 5-fold cross-validation. Every fold will have the training and testing data. SMOTE-N will be applied in the training data, and then the training data will be classified using random forest. The model obtained will be tested using training data, and the performance of the model will be evaluated using accuracy, sensitivity, specificity, and G-means.
3 Results and Discussion

In this paper, we classify the adolescent risk behavior of drug abuse that has binary classes. Figure 1 shows the class distribution of the drug consumption variable. The total data are 5300, of which the minority class (consuming drug) has 192 data, and the majority class (not consuming drug) has 5108 data.

![Figure 1. Percentage of Adolescent Risk Behavior of Drug Abuse](image)

The adolescent risk behavior of drug abuse data is partitioned into 5-fold cross-validation. Every fold will contain about 4240 training data and 1060 testing data. The training data consist of about 4086 data in the majority class and about 154 data in the minority class. In comparison, the testing data will have about 1022 data in the majority class and about 38 data in the minority class. This condition shows that there is a class imbalance in the data. Hence, it needs to handle the imbalanced data using SMOTE-N in the training data. After SMOTE-N is applied, the data in the minority class increases. The data distribution can be seen in Table 1.

<table>
<thead>
<tr>
<th>Table 1. Class Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Original Data</strong></td>
</tr>
<tr>
<td>Majority</td>
</tr>
<tr>
<td>Fold 1</td>
</tr>
<tr>
<td>Fold 2</td>
</tr>
<tr>
<td>Fold 3</td>
</tr>
<tr>
<td>Fold 4</td>
</tr>
<tr>
<td>Fold 5</td>
</tr>
</tbody>
</table>

The performance of random forest without handling the imbalanced data and with handling the imbalanced data using SMOTE-N are shown as below.

<table>
<thead>
<tr>
<th>Table 2. Performance of Original Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accuracy</strong></td>
</tr>
<tr>
<td>Fold 1</td>
</tr>
</tbody>
</table>

The performance of random forest without handling the imbalanced data and with handling the imbalanced data using SMOTE-N are shown as below.
From Table 2, it can be seen that the average accuracy is 96.4%, and the average sensitivity is 96.4%. Although the accuracy and sensitivity are high, the specificity is 0%. Without handling the imbalanced data, the model cannot correctly classify the data in the minority class or adolescents using drugs.

Table 3. Performance of SMOTE-N

<table>
<thead>
<tr>
<th>Fold</th>
<th>Accuracy</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>G-Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.722</td>
<td>0.995</td>
<td>0.105</td>
<td>0.323</td>
</tr>
<tr>
<td>2</td>
<td>0.687</td>
<td>0.990</td>
<td>0.090</td>
<td>0.298</td>
</tr>
<tr>
<td>3</td>
<td>0.765</td>
<td>0.979</td>
<td>0.083</td>
<td>0.285</td>
</tr>
<tr>
<td>4</td>
<td>0.662</td>
<td>0.990</td>
<td>0.084</td>
<td>0.288</td>
</tr>
<tr>
<td>5</td>
<td>0.683</td>
<td>0.982</td>
<td>0.072</td>
<td>0.266</td>
</tr>
<tr>
<td>Average</td>
<td>0.704</td>
<td>0.987</td>
<td>0.087</td>
<td>0.292</td>
</tr>
</tbody>
</table>

Table 3 shows the average accuracy of the model with SMOTE-N is 72.5%, or in other words, the overall adolescent risk behavior of drug abuse was correctly classified as much as 72.5%. The model with SMOTE-N obtained high sensitivity and increased specificity and g-means. Thus, the SMOTE-N model can capture the data in minority class or the adolescents who are using drugs.

Table 4. Performance Comparison

<table>
<thead>
<tr>
<th></th>
<th>Accuracy</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>G-Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original</td>
<td>0.964</td>
<td>0.964</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>SMOTE-N</td>
<td>0.704</td>
<td>0.987</td>
<td>0.087</td>
<td>0.292</td>
</tr>
</tbody>
</table>

Table 4 shows the performance comparison of random forest without handling the imbalanced data and using SMOTE-N. The accuracy of the model with SMOTE-N is lower than the accuracy of the model with original data, but the former's sensitivity is higher. Using SMOTE-N can increase the model's specificity from 0% to be 8.7% and increase the G-means significantly to 29.2%.

Figure 3 shows the variables importance in the model that uses SMOTE-N. The higher the MDG, the more influential the variable is. Figure 3 shows that the age variable has the highest MDG of 446 compared to the other variables. It means that age is the most crucial variable in determining adolescent risk behavior of drug abuse. The next most important variables are sex and psychological consequence with MDG as much as 304 and 208. The least essential variable is ASRH, with the lowest MDG, which is 40.
This study shows that age is the most crucial variable in determining adolescent risk behavior of drug abuse. This result agrees with the research done by [15] and [16], which found out that age affects the use of drugs such as narcotics, alcohol, psychotropic substances, and addictive substances. In this study, age is in continuous attribute, referring to research in Iran, which found that adolescents who consume drugs and alcohol are about 17-18 years old. Another research in Indonesia shows that drug abuse behavior tends to be exhibited by adolescents in the group of 20-24 years old rather than the group of 15-19 years old.

The next most crucial variable is sex. This result is congruent with the research done by [17], which found that most people who abuse drugs are male. [18] also showed that gender affects drug abuse and alcoholism. In Brazil, most of the alcoholism are male adolescents. In Indonesia, the same results were found in how gender affects drug abuse, and that male adolescents tend to be more vulnerable to drug abuse [16].

The knowledge of the psychological consequence of drug abuse is the third most crucial variable. The risk behavior faced by adolescents is related to psychology. The knowledge of the psychological consequence of drug abuse is an essential factor in drug abuse behavior [19]. In this study, there are six indicators of psychological consequences: brutal behavior,
delusional behavior, difficulty in concentrating, anxiety, self-harm, and suicidal thoughts. This condition is unexpected and can encourage adolescents to engage in negative behavior, including drug abuse.

4 Conclusion

The original data model has the highest accuracy, 96.4%, but the specificity and the G-means are 0. It shows that the model without handling the imbalanced data cannot capture the data in the minority class. While the SMOTE-N model for handling the imbalance data obtained a lower accuracy, it also has higher sensitivity, specificity, and G-means than the original data model. Hence, the best model is the model with SMOTE-N. From the best model obtained that the variables affect the classification of the adolescent risk behavior of drug abuse are age, sex, and psychological consequence.

Acknowledgments. This research was funded by BKKBN. The authors thanks to BKKBN for funding which support this research and all individuals associated with this research work.

References

Pseudo Thinking of the Social Arithmetic: A Case Study

Lathifah Rahmi¹, Sufyani Prabawanto²
{lathifahrahmi88@upi.edu¹, sufyani@upi.edu²}

Mathematics Education Department, Universitas Pendidikan Indonesia, Jl. Dr. Setia Budhi No. 229, Bandung 40154, Indonesia ¹²

Abstract. The purpose of this study is to describe the student's error of pseudo thinking of social arithmetic. The subjects were five students of 8th-9th grade. This research is a case study. Data was collected through student worksheets and interviews. The study was conducted were 40 minutes each for five meetings. Students' understanding was evaluated for the first twenty minutes using the social arithmetic problem, and then we carried on the interview for the next twenty minutes. As a result of this study, subjects still experience error thinking based on pseudo thinking theory. The subjects' type of error thinking is including conceptual pseudo thinking and true pseudo thinking on the material of social arithmetic pseudo. The causal factors include that the subjects do not really understand the interpretation of the question, and they do not understand the interpretation of the formula used.

Keywords: Pseudo thinking, Social arithmetic.

1 Introduction

The process of thinking as the foundation when someone is learning will improve if the one starts to think. Students think as if they were joining the process of thinking, but what the students think does not comply with the process of thinking. The students’ right answer is not always derived from the right mindset, because we do not know what the students think [1]. Students focus only in completing and searching for the answer, not to understand whether the answer represents the problem or not [2][3]. This is called a pseudo thinking condition [4].

Pseudo thinking is thinking fictively, which means in solving a problem, it is possible that students do not really think about how to acquire the answer to the problem given [5]. Pseudo thinking is related to one's belief which has not been proven. A lot of philosophers claim that the truth of knowledge is not always in line with belief [6]. Pseudo thinking deserves more attention as one piece of knowledge about the occurrence of error in one's mathematical thinking [7]. Students’ error thinking in solving mathematics problems needs attention, if not immediately resolved, the error will have an impact on students' understanding of the next mathematics concept [4].

Error based on the pseudo thinking theory are divided into two views, namely pseudo thinking which was proposed by Vinner based on the process and pseudo thinking proposed by Subanji based on the final result (final answer). Pseudo thinking based on the process is divided into two, namely pseudo conceptual thinking and pseudo analytical thinking [8]. Pseudo conceptual thinking occurs if students in learning are unable to think about a concept, meaning
and relationship, however, they can yield answers that seem conceptual in solving the problem. Meanwhile, pseudo analytical thinking occurs if students do not act as expected, not complying with the suggested process of thinking in solving problem, and not even find various ways, but can generate an answer that seems to be analytic in solving the problem. Pseudo thinking based on the final result (final answer) is divided into two, namely true-pseudo thinking and false-pseudo thinking [9]. True-pseudo thinking occurs if the students who give a correct answer are unable to provide justification to the answer; the answer is "pseudo truth" or true-pseudo [9]. Meanwhile, false-pseudo thinking occurs if students give a wrong answer but after doing some reflection they can fix it so that it becomes a correct answer.

Pseudo occurs when understanding mathematical problems, where the mathematical ability that is understood is still raw and does not correspond to real conditions [10]. The concept of mathematics learning material is identical to the problems of everyday life, one of which is social arithmetic. Social arithmetic is a frequent subject used in everyday life, at work or for studying other subjects because they discuss a financial calculation in commerce and everyday life along with its aspects [11][12]. Learning activities in social arithmetic are learning activities that go directly to everyday life and in these questions contain story questions in them [13].

Previous research shows that there are students who experience error thinking based on pseudo thinking theory on the concept of fraction [14]. The result of the study shows that students experience pseudo conceptual thinking when students do not understand the need to shading when drawing a fraction, and true-pseudo thinking when the students do not understand the concept of drawing a fraction from the same size and breaking it down to the same number as the fraction denominator, and false-pseudo thinking when students do not understand the problem and the reflection is necessary for the concept of drawing a fraction [14]. There is also research on students' errors based on Newman Stages in social arithmetic material which found that the mistake of the students on the type error I (reading error) of 8.33%, the type of error II (reading comprehension difficulty) of 13.64%, type error III (transform error) of 14.39%, type error IV (weakness in process skill) of 31.82%, error type V (encoding error) of 31.82% [15]. Thus, this study aims to describe students' pseudo error thinking on other mathematical material concepts, namely the concept of social arithmetic.

2 Method

This research is a case study research. Qualitative case study is an approach to research that facilitates exploration of a phenomenon within its context using a variety of data sources [16]. The case in this study is about pseudo thinking and social arithmetic concept. There are 5 children with the range of 8th-9th grade as subjects. All subjects had previously studied the concept of social arithmetic in 7th grade. The data collected use the student worksheet and interview. Students' answers are analyzed. If there is an answer from a student who has a pseudo-thinking error in the completion or process step, then during the interview, it will be analyzed whether the student is experiencing pseudo conceptual or pseudo analytic. However, if there is a student's answer who has a pseudo-thinking error in the final result or the final answer, then during the interview, it will be analyzed whether the student is experiencing true-pseudo or false-pseudo. The study is held in five meetings, in 40 minutes for each subject. Students' understanding is evaluated for 20 minutes using social arithmetic problem and interview for 20 minutes. There are 4 social arithmetic problems. The problems were adopted from 7th grade high school mathematics book.
3 Result and Discussion

There are four problems in this research. The focus of the problem is on social arithmetic material. Five subjects selected in this study experienced all kinds of pseudo error thinking, namely pseudo conceptual, pseudo analytic, true pseudo, and false pseudo in social arithmetic material.

3.1 Problem 1

A meatball seller spends IDR 1,000,000.00 to run his business. He sets the price of the meatball IDR 8,000 per portion. If he plans to get minimum profit of IDR 250,000.00 from the sale, then what is the minimum portion that should be made?. Problem 1 asks the minimum benefit of the social arithmetic problem being presented. Subjects 1 and 2 could answer problem 1 properly and correctly. Subjects 3, 4 and 5 used a correct concept, but made the same mistake which generated the final result of 156 portions.

Based on this case, the subject resolves the problem. It is possible that the participant students did not really think about how to get an answer to the given problem [5]. At the time of the interview subjects 3, 4 and 5 said the same reason, when they were asked “Why is the answer 156 portions?”. The answer from each of them was “because final result obtained is 156.25 and if rounded using the rounding rule it becomes 156, so the final result is 156 portions”. From the result of the test and interview, subjects 3, 4 and 5 were unable to think about the concept of rounding according to the question request. A condition such this is related to the error thinking based on pseudo thinking theory with pseudo conceptual characteristic. In accordance with the explanation that pseudo conceptual thinking occurs when students in learning is not able to think about a concept, meaning and relationship, however they can generate an answer that seems conceptual in solving a problem [8]. So it can be concluded that subjects 3, 4, and 5 experienced the error thinking based on pseudo thinking theory with pseudo conceptual characteristic.

3.2 Problem 2

Mr. Iqbal sells a (new) laptop for IDR 4,000,000.00 (without tax). The laptop was purchased by Mr. Ro'uf with a Value Added Tax (VAT) of 10%. Determine the money which should be paid by Ro'uf (including tax). Problem 2 asks the price of an item that has been taxed on a social arithmetic problem. All subjects correctly solved problem 2. However, on the interview session
subject 5 could not answer the question from the researchers about the amount of tax Value Added (VAT).

\[
\begin{align*}
2. & \quad \frac{100 + \text{tax}}{100} \times \text{price} \\
& \quad \frac{100}{100} \times \text{IDR } 4,000,000 \\
& \quad \frac{100}{100} \times \text{IDR } 4,000,000 = \text{IDR } 4,400,000 \\
\end{align*}
\]

Fig. 2. Subject 5 answer sheet of problem 2

Evaluating from subject 5’s answer sheet, he solved problem 2 using the same conceptual method of a formula, but when asked “How much is the Value Added Tax (VAT)?” Subject 5 answered “I don't know the amount of Value Added Tax (VAT), I just know the price for the laptop which is paid by Mr. Ro'uf”. In a condition such this, the subject did not reflect, gave a spontaneous response without realising what was being done, and did not show any encouragement to check the correctness of the answer [8]. From the result of the interview, it can be seen that the subject gave a correct answer but is unable to justify the answer he did [9]. So it can be concluded that subject 5 experienced the error thinking based on the pseudo thinking theory with true pseudo characteristic.

3.3 Problem 3
A seller buys clothes from a wholesaler for IDR 30,000. The clothes are sold with a label of IDR 60,000.00 with a 20% discount written on it. Determine the seller's profit, say the clothes are sold. Problem 3 question the earned profit after getting a discount in social arithmetic problem. All subjects resolved this problem 3 properly and correctly and with conceptual finishing steps. During the interview, all subjects also answered with a correct answer and understanding. So it can be concluded that all subjects did not experience error thinking based on pseudo thinking theory on this problem 3.

3.4 Problem 4
Pak Bagus loaned money from a bank as much as IDR 2,000,000.00. He paid the loan in instalment with a nominal of IDR 100,000.00 per month, for 2 years. Determine the annual interest percentage required by the Bank. Problem 4 is about a social arithmetic problem and questioning the annual interest used by a bank. Subjects 2, subject 3, and subject 4 could not answer problem 4 correctly. While subject 1 and subject 5 by pseudo answer. During the interview, subject 1 said that "I can solve this problem".
### Known:
- Loan amount = 2,000,000
- Monthly instalment = 100,000
- Time Instalment = 2 years = 24 month

The annual interest percentage?

The amount of money paid over the past 2 years = 100,000 × 24 = 2,400,000

Interest bank = 2,400,000 - 2,000,000 = 400,000

The annual interest percentage = \( \frac{400,000}{2,000,000} = 5\% \) per year

---

**Fig. 3.** Subject 1 answer sheet of problem 4

The concept used by Subject 1 is correct. However, subject 1 did not realise that the final result he got was the percentage of interest for 2 years, while the question asked about the percentage of interest per year. From the result of test and interview, it can be seen that the subject is not capable to think about the meaning of the concept they used [8]. The meaning of the concept that subject 1 used did not show the result of what the question ordered. Hence, it can be concluded that subject 1 experienced error thinking based on pseudo-thinking theory with pseudo conceptual characteristic.

What is written by subject 5 in problem 4 has the same solution but the result is different from subject 1’s.

### Problem 4

\[
\begin{align*}
4. \ (\text{Loan amount} + \text{Interest bank})/\text{Time instalment} \\
&= \frac{200,000}{12} \\
&= \frac{2,000,000 + \text{Interest bank}}{12} \\
&= \frac{2,000,000}{12} + \frac{\text{Interest bank}}{12} \\
&= \frac{2,400,000}{12} + \frac{\text{Interest bank}}{12} \\
\text{Interest bank} &= 2,400,000 - 2,000,000 = 400,000 \\
\text{Interest bank of 12 month} &= \frac{12}{12} \times \text{Interest percentage} \times \text{asset} \\
&= \frac{400,000}{1} = \text{Interest percentage} \times 2,000,000
\end{align*}
\]
During the interview, subject 5 said “I can solve problem 4 with a formula that I got from the book”. The same way as subject 1, the concept used by subject 5 is already right. However, subject 5 did not realise that the final result he got was a percentage interest for 2 years, while the question asks the percentage of interest per year. From the result of test and interview it can be seen that the subject is unable to think about the meaning of the concept he uses [8]. The meaning of the concept that subject 5 used did not show the result of what the question ordered yet. Hence, it can be concluded that subject 5 experienced error thinking based on pseudo thinking theory with conceptual pseudo characteristic.

4 Conclusion

From this research, obtained an overview of students’ pseudo thinking mistakes on the concept of social arithmetic. The subjects studied in this study are still experiencing error thinking based on pseudo thinking theory. The type of error thinking experienced by the subjects is including pseudo conceptual thinking and true pseudo thinking in social arithmetic material. The causal factors include that the subjects do not understand the meaning of the question and do not understand the meaning of the formula used.
References


Students’ Difficulties in Solving Ratios and Proportional Relationships Problems

Nabila Ismi Fauziah\textsuperscript{1}, Endang Cahya M.A.\textsuperscript{2} \{nabilaismi12@student.upi.edu, endangcahya@gmail.com\}\textsuperscript{2}

Universitas Pendidikan Indonesia, Dr. Setiabudi No. 229, Bandung 40154, Indonesia\textsuperscript{1,2}

Abstract. This study aims to describe students’ difficulties in solving ratios and proportional relationships problems. Qualitative research using the described method was the methods of this research which cover three stages. First, we developed four problems on ratios and proportional relationships. Second, we tested the problem with ten students in Grade 8th (15-16 years old) and interviewed all students about their solutions to the problem. Finally, we analyzed student answer papers and the results of the interviews that had been conducted. The results showed that are three common types of students’ difficulties in solving ratios and proportional relationships problems: (1) difficulty in ratios and proportional relationships word problems, (2) difficulty in applying arithmetic operations, and (3) difficulty in understanding the concept of ratios and proportional relationships.

Keywords: Students’ Difficulties, Ratios and Proportional Relationships.

1 Introduction

Mathematics is necessary knowledge and very important for all students. One of the mathematical concepts often applied in everyday life is ratios and proportional relationships\textsuperscript{1}. The Common Core State Standards for Mathematics (CCSSM) consider ratios and proportional relationships topics as one of the curriculum’s five critical areas in grades 6th and 7th\textsuperscript{2}. The concepts of ratios and proportional relationships are prerequisite materials for mathematical concepts at a higher level. Even the concepts of ratios and proportional relationships are often used in many other concepts beyond mathematics\textsuperscript{3–6}. Therefore, students had to master the concepts of ratios and proportional relationships as a bridge to mastering advanced mathematics.

Despite the concept of ratios and proportional relationships being essential, Indonesian students’ learning outcomes on this concept show the opposite result. Based on the results of Trend in International Mathematics and Science Study (TIMSS) 2011, the overall average of Indonesian students who correctly answered TIMSS 2011 questions in the domain of content was 24 percent, while the average of international students was 43 percent\textsuperscript{7}. It shows that the Indonesian students have difficulties in the number content domain, including ratios and proportional relationships.

The National Examination Report conducted by the Indonesian government in 2018, show that students’ performance in solving ratios and proportional relationships problems in West Java Indonesia, especially in Bandung district, is still low; worth 39.50 lower than the average national exam results throughout Indonesia 44.51\textsuperscript{8}. This indicates that Indonesian students, particularly in the Bandung district, have some difficulties with this problem.
Andini classified four categories of the difficulties experienced by elementary students in solving ratios and proportional relationships problems, such as (1) difficulty understanding the problem given, including unable to understand the phrases or keywords in the problems, confused in determining the problem-solving strategies; (2) difficulty solving the problem due to the low ability to perform integer and fraction operations; (3) difficulty when applying the concept of comparison to solve the problem.; and (4) difficulty when working on problems that have a different context from what they had learned [5]. These difficulties may lead to another difficulties or misconception of other related concepts [9]. In other words, students at a higher level may still have these difficulties or perhaps other difficulties in solving ratios and proportional relationships problems.

To further investigate student difficulties in solving ratios and proportional relationships from the perspective of junior high school students, this research will describe students' difficulties in solving ratios and proportional relationships problems. We focus on the ratios and proportional relationships for students in grade 7th of junior high school in Indonesia.

2 Methods

This research is qualitative research using the descriptive method to described students' difficulties in solving ratios and proportional relationships problems. This is in line with the purpose of descriptive research to describe a phenomenon and its characteristics [10] The descriptive methods in this study included three stages. First, we designed three problems on ratios and proportional relationships. Those problems were presented in Table 1. Those problems were adopted and adapted from the Indonesian National Exam and the students’ textbook. Second, we tested the problem on ten students of junior high school grade 8 (14-15-years old), and we interviewed the students about their solutions for the problem given. The interview was recorded so that all student answers could be recorded in detail. Finally, we analysed student answer papers and the results of the interviews that had been conducted to classify students' difficulties in solving ratios and proportional relationships problems.

Table 1. Design ratios and proportional relationships problems.

<table>
<thead>
<tr>
<th>No.</th>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>If we know the value of ( A = \frac{2}{3} I ) and ( I = \frac{2}{5} R ). Then find the ratio of ( A, I, ) and ( R )!</td>
</tr>
<tr>
<td>2</td>
<td>A car moves 120 kilometers within 2 hours, while a bike moves 100 meters in 2 minutes. Determine the ratio of a car and bike speed!</td>
</tr>
<tr>
<td>3</td>
<td>A contractor can complete a job within 40 days with 15 workers. If every worker has the same skill, determine how many additional workers must finish a job in 30 days?</td>
</tr>
<tr>
<td>4</td>
<td>Mrs. Widi works in a training facility with a salary of 2 hours is Rp. 63,000. Determine the time of training by Mrs. Widi if she gets a salary of Rp. 283,500?</td>
</tr>
</tbody>
</table>
3 Results and Discussion

Based on written test and interview analysis, we identified three common types of difficulties displayed by the students, such as (1) difficulty in ratios and proportional relationships word problems, (2) difficulty in applying arithmetic operations, and (3) difficulty in understanding the concept of ratios and proportional relationships. It reveals that the difficulty in understanding the concept of ratios and proportional relationships was the most frequent category, following by difficulty in applying arithmetic operations and the difficulty in ratios and proportional relationships word problems.

3.1 Difficulty in ratios and proportional relationships word problems

The difficulty in ratios and proportional relationships word problems refers to students' inability to understand the meaning of contextual word problems in ratios and proportional relationships topics. This difficulty included: students did not understand the problem given, mistranslated words or phrases into mathematical notations or formulas, and mistakes in choosing a plan to solve the problems. This difficulty is mainly seen in students’ answers to problems number 3, 4, 1, and 2. Examples of student responses relevant to this category of difficulty can be seen in Figure 1(a) and Figure 1(b).

Figure 1(a) is an answer paper of a student S5 while trying to solve problem number 1. We can see that S5 did not understand the problem given; S5 could not write what is known and what is asked in the problem. When the interview was conducted, S5 said that the known is a whole question 1 (re-read problem number 1). S5 did not get partially what is known and what is asked in the problems. For problem number 1, S5 was asked about the meaning of \( \frac{A}{3} = \frac{2}{3} \) and answered “A is two-thirds, and one” S5 read “I” as a number (one). S5 mistranslated mathematical notation into numbers, resulting in a non-ratios and proportional relationships relation but a mixed fraction. This difficulty could occur because the students never use the format of ratios such as this problem, and students could not differentiate fractions as a ratio language. This finding is in line with the findings of studies performed by Irfan et al., where students did not understand the difference in ratio, fractional, and division [11].

Figure 1(b) is an answer paper of a student S10 while trying to solve problem number 2. Understanding the unknown in the problem will determine what will be done in the final stage [12]. This reflects S10 answer; S10 did not understand what is unknown or what is asked from the problem can make a mistake in determining a plan to solve the problem. S10 made a mistake in deciding the formula used to solve the problem. Problem number 2 asks students to compare
travel speeds by car and bicycle. It required students to use the formula of speed (distance divided by time) to obtain the relationship between two ratios (proportion). However, S10 compared the distance travel by car and the distance travel by bicycle, then combined it with a comparison of the time by car and bicycle.

Another effect of this difficulty is that students did not answer the questions thoroughly. There are missing steps conducted by the students. Student S9 had this difficulty in trying to solve problem number 3. Question number 3 is how many additional workers are required, but S5 answered only up to the workers' total number. S5 missed one step, where S5 needed to reduce workers' total number from the last number of workers.

3.2 Difficulty in applying arithmetic operations

Difficulty in applying arithmetic operations refers to students’ mistakes and misconceptions about arithmetic operations (prerequisite material). This difficulty included: student make a mistake while doing addition, subtraction, multiplication, or division operations, student did not comply with the rules of the arithmetical operation order, student misapplied a commutative and associative property in calculation a division operation, student misapplied an additive or multiplicative inverse, and student misapplied cross-multiplication procedure. Examples of student responses relevant to this category of difficulty can be seen in Figure 2(a) and Figure 2(b).

Figure 2(a) is an answer paper of a student S8 while trying to solve problem number 1. We could see that S8 misapplied multiplication inverse in changing $A = \frac{2}{3} \cdot \frac{3}{2} \cdot A$ to $I = \frac{2}{3} \cdot A$ (supposedly $I = \frac{3}{2} \cdot A$) and changing $3R = 5A$ to $R = \frac{3}{5} \cdot A$ (supposedly $R = \frac{5}{3} \cdot A$). One possible causes is that S8 did not master enough division operations infractions (multiplication inverse infraction), which is the prerequisite material of ratios and proportional relationships topics. When interviews were conducted, S8 asks to divide two by $\frac{2}{3}$, but S8 answer is $2 + \frac{2}{3} = \frac{2\times2}{3} = \frac{4}{3}$. S8 did not understand there are different procedures of multiplication and division operations infractions. Students lack understanding of prerequisite material of fractions. This finding is in line with Daugherty’s opinion that state misconceptions related to ratios and proportional reasoning depend on prerequisite knowledge of multiplication and fraction [3].
Figure 2(b) is an answer paper of a student S7 while trying to solve problem number 3. We can see that S7 is trying to use the cross-multiplication procedure, but S7 confuses the step and what operation can be used in that procedure. There are missing steps in the S7 answer. First, S7 needs to change the proportion from $\frac{40}{30} = \frac{15}{a}$ to $40 \times a = 30 \times 15$. Then uses multiplication inverse S7 can obtain $a = \frac{40 \times 15}{30} = \frac{450}{40} = 11.25$. But this answer is still wrong because of the incorrect proportion made by S7. S7 had another difficulty in solving these problems, such as difficulties in understanding the ratios and proportional relationships concept that will discuss in the next section.

3.3 Difficulty in understanding the concept of ratios and proportional relationships

Difficulty in understanding the concept of ratios and proportional relationships refers to students’ inability to use the different ratio formats, not compare two measure of the same types of things, confused about the concept of ratios with fractions and division operation, cannot simplify the ratio form to its simplest form, and student cannot differentiate between the concept of direct proportion and inverse proportion. Some students could not use a different format of ratios in solving problem number 1, and they could not write the ratio of three quantities $(A: I: R)$, so they did not solve the problem entirely or did not solve the problem. Examples of student responses relevant to this category of difficulty can be seen in Figure 2(b) and Figure 3.

In Figure 2(b), student S7 made a mistake using the formula of inverse proportion. From the interview conducted, S7 cannot distinguish between the concept of direct proportion and inverse proportion. S7 did not remember there another formula to solve inverse proportion problems. This finding is in line with the research results that Diba conducted that students were not properly knowledgeable about the problem of direct and inverse proportions [13].

Fig. 3. Example of student responses with difficulty in understanding the concept of ratios and proportional relationships

Figure 3 is an answer paper of a student S3 while trying to solve problem number 2. Problem number 2 requires students to comparing two ratios (proportion), the travel speed of the car in kilometers per minute and the travel speed of a bicycle in meters per second. When comparing two ratios (proportion), two requirements need to follow. One of the requirements is comparing two quantities with the same types of measure [3]. However, S3 did not follow those requirements. S3 did not change the type of measure as one of the ratios, so the obtained answer is wrong. It implies that students lack an understanding of ratios and proportional relationships concepts.
4 Conclusion

Many of the difficulties experienced by students emerge in question number 1. Students need to determine the ratio of three quantities and question number 3, which students need to use the concept of inverse proportion to find the additional workers to be hired. Based on these findings, it can be concluded there are three common types of students’ difficulties in solving ratios and proportional relationships problems, such as (1) difficulty in ratios and proportional relationships word problems, (2) difficulty in applying arithmetic operations, and (3) difficulty in understanding the concept of ratios and proportional relationships. The cause of these difficulties is due to students’ lack of basic knowledge about prerequisite material, such as in the concept of fraction and arithmetic operations procedures, students’ lack of comprehension when solving word problems with proportional ratio and relationship, and students’ lack of conceptual understanding of ratios and proportional relationships topics. Therefore, it would be better to do further research on the causes of students’ difficulties in solving ratios and proportional relationships problems to enhance students’ comprehension in various classes or schools.

Acknowledgments. We would like to thank Prof. Turmudi, M.Ed., M.Sc., Ph.D. for his constructive comments and suggestions. We also thank the teachers and students for their participation.

References


The Impact of Learning in Nature for The Well-being of Children with Special Needs

Melati Ismi Hapsari¹, Lia Mareza²
{melshapsari@gmail.com¹, liamareza@ump.ac.id²}

Department of Early Childhood Education, Faculty of Teacher Training and Education, Universitas Muhammadiyah Purwokerto ¹,
Department of Elementary Education, Faculty of Teacher Training and Education, Universitas Muhammadiyah Purwokerto ²

Abstract. The high number of children with special needs in Indonesia requires serious handling from various parties. An accessible approach is needed for children from lower economic backgrounds, as well as for those in areas far from health and educational services. Learning activities in nature using natural media can be a good suggestion and solution. This study aims to examine the positive impacts of nature-based learning on the well-being of early-aged children with special needs. The method in this research is a one-shot experimental design. This study used a qualitative and descriptive technique to analyze the data. The results showed that learning carried out in nature can significantly improve children's well-being and their development achievement.

Key Words: Special Needs, Early Childhood, Learning in Nature, Children Well-being

1 Introduction

First of all it is important to underline what is or who are children with special needs? Several experts prefer to use the term of special needs or exceptional children to replace the term of handicapped children or children with disability [1]. Moreover, they can be classified as follows: Mental Retardation, Autism, Learning Disability, Attention Deficit and Hyperactive Disorder, Emotional and Behavior Disorder, Speech and Language Disability, Visual Impairment, Hearing Impairment, Physical Disability, and Giftedness [2].

The prevalence of children with special needs tends to increase every year in many countries. However, there is still very limited data in Indonesia. This is due to the limited number of studies that specifically examine this problem. Based on a report from the World Health Organization (WHO) [3] there are around 4.2 million children with special needs in Indonesia, most of them were detected at an early age.

WHO [3] estimates that the number of children with disabilities is around 7-10% of the total population of children. Moreover, based on data from the 2012 Indonesian National Health Survey [4] the percentage of children with special needs in Indonesia is 81.81% at the primary school age level and below (Early Age), where overall only 14.4% are in educational institutions or taking therapy in private or government-owned rehabilitation centers.

The high number of children with special needs in Indonesia urge serious attention from various parties. Children with special needs have relatively different conditions of ability and potential development. These conditions could cause obstacles to several aspects of life such
as academics, social communication, and the fulfillment of daily life activities. Therefore, special and inclusiveness services in education are really needed.

An adequate and appropriate service particularly in the educational field can help the children avoid and overcome their learning barriers, and can help them to be more adaptive in their society. Furthermore, it also can reduce the existing negative symptoms and maximize their potential optimally. This can affect the quality of life of children with special needs, and in general, it can give a positive impact on the development of Indonesian human resources.

The Indonesian government has paid great attention to the problems of children with special needs since a decade ago, especially through the policy of inclusive education. Banyumas Regency is one of the districts in Indonesia that has declared itself an inclusion district since 2016. The Banyumas Regency Education Office [5] noted that there were 2,962 children with special needs in this area who were successfully recorded. Furthermore, the Banyumas District Education Office designated 542 elementary schools as educational units that provide inclusive education services. There is at least one elementary school that provides inclusive education in each sub-district. However, other types of schools, including Early Childhood Education (PAUD) that have not been designated as providers of inclusive education services, are not allowed to refuse prospective students with special needs.

Unfortunately, as happened in many areas in Indonesia, the crucial problem is related to confusion toward teachers to provide inclusive services, especially at the level of preschool. Most preschool institutions are still unable to move away from monotonous learning activities that are more oriented towards academic achievement. This in turn makes it more difficult for children with special needs to achieve adequate developmental growth and therefore it makes them more difficult to adapt.

In Banyumas Regency, there are 810 preschools across 27 sub-districts, where each institution has at least one child with special needs on average. In addition, the quality of handling children with special needs in early childhood education institutions in the Banyumas district was generally at a moderate level [5]. In terms of quality, there needs to be an increase in the variety of learning activities that can accommodate children's development to be more optimal.

Based on these facts, there need to be holistic and integrated handling steps through integrated treatment with the education curriculum in schools, especially at the basic education level. The Indonesian government signed the convention on March 30th, 2007 in New York. This shows the seriousness of the Indonesian state to respect, protect, fulfill, and advance the rights of persons with disabilities, including in education services. In realizing an independent and quality education system as regulated in Law no. 20 of 2003 concerning the National Education System, it is necessary to make various strategic and integral efforts that support the implementation of education [6]. The opportunity to obtain quality education applies to all (Education for All) from early childhood to higher education.

On the other hand, there is a need for an approach that can be more easily accessed for children with special needs, especially those from the lower economic class, in rural areas, and far from health services, especially therapy services in clinics and hospitals. Various scientific literature discusses a lot about activities in nature and various natural media that can have a positive impact on children with special needs [7][8].

Several theories and research results find a significant relationship among children's interactions, the natural environment and a decrease in negative symptoms of children with special needs, as well as an increase in the quality of their mental health [9][10][11]. In addition, free play in the natural environment can improve the quality of children's social interaction as well as enthusiasm and ability to concentrate [12][13][14].
Many areas in Indonesia including Banyumas Regency, especially in rural areas, have many natural open spaces, such as rice fields, gardens, and rivers, along with various natural media such as plants, seeds, flowers, leaves, dry branches, and twigs, rocks, gravel, water, sand, etc. which can be used as a learning medium as well as an integrated yet easy and inexpensive therapeutic tool for children with special needs in preschool.

In Banyumas Regency, a small number of preschools used nature as a learning setting and media, including for students with special needs. It is important to find the impact of learning in nature toward children with special needs, at least how the effectiveness on the well-being of the children. Therefore, these are the two aims of this study:

1) To find the effectiveness of learning in nature on the well-being of the children with special needs.
2) To identify what is the main factor in nature learning that affects the well-being of children with special needs.

2 Method

2.1 Participants

This study used a qualitative approach. The method used in this research is an experimental research method with the model of One-Shot Case Study in which a group was given treatment and the results were then observed. In this case, nature-based learning was the treatment as an independent variable. The dependent variables in this study are 1) The psychological well-being of early-aged children with special needs, 2) The developmental achievement of early-aged children with special needs.

Subjects

The subjects in this study were the students of a preschool named Taman Bermain Qaryah Thayyibah (TB QITA). Purposive sampling was applied in this study based on the reason that this institution has implemented nature-based learning activities for its students, where 60% of learning activities are done outdoors, particularly in nature. The research subjects were 3 children with special needs with relatively different diagnoses, symptoms, and developmental characteristics.

2.2 Data Collection

The data were collected through 3 main techniques:

1) Observation

Depth observation was held to the subjects, based on certain indicators of well-being: a) the emergence of positive emotion, i.e. happiness, excitement, and enthusiasm, with the score of the scale ranged from 0 as inadequate to 7 as adequate; b) the emergence of negative emotion, i.e. sadness, anger, anxious, worried, scared, and frustration, with the score ranged from 0 as inappropriate to 7 as appropriate; c) the decline of negative symptoms of the disorders. The negative symptoms measured in this study through observation were temper tantrum, aggressive or uncooperative behavior, lack of communication and interaction, not able to focus.
Observation also focused on the improvement of the developmental milestone of the subjects on the whole aspects (cognitive, language, fine motor and gross motor skills, as well as social and emotional).

Moreover, the observation was delivered in several particular events: classroom learning activities, individual educational program, home visit activity.

2) Interview

Researchers conducted the in-depth interview toward the subjects, side by side with the observation. The interview also included the teachers and the parents. It aimed to explore more data about the well-being and the developmental milestone of subjects as above. It also enriched the important data to find what is the main factor of nature-based learning affected to the well-being of the subjects.

3) Documentation

Several supporting data were collected in this study, i.e. the instruments of curriculum, manual of learning activities, a list of student's names and detailed information, a report of the student's developmental milestone, a report and manual of therapy activity, and also the documents of the process and results of the treatment in the form of photos and videos.

3 Result and Discussion

3.1 Description of Research Location and Subjects

The location of the study was in a preschool which provided outdoor learning activity, and used nature as the setting and media of the learning activity. The location of the study was in that preschool named Taman Bermain Qaryah Thayyibah (TB QITA).

In TB QITA there were about 60% of learning activities delivered outdoors. Learning activities at this institution were carried out in a model of Beyond Centers and Circle Time (BCCT) which means there are approximately 8 to 12 children in one class, with several groups named Centers to facilitate various potentials and needs of children. The setting of the seat used a circle model, to provide maximum contact and interaction between teachers and students. The total number of students in TB QITA was 30, and 7 ones have neurodevelopmental disorders or special needs. The three children were taken randomly as research subjects.

The table below describes the three subjects and the information about the disorders.

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Gender</th>
<th>Age</th>
<th>Category of Special Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AHM</td>
<td>Male</td>
<td>6 y</td>
<td>Attention and hyperactivity disorder (ADHD)</td>
</tr>
<tr>
<td>2</td>
<td>MRAF</td>
<td>Male</td>
<td>5 y</td>
<td>General developmental delay which is caused by genetic multifactor (cytomegalovirus, microcephaly, cerebral atrophy, bronchopneumonia, right hearing loss 90db and left 70db)</td>
</tr>
<tr>
<td>3</td>
<td>AAZ</td>
<td>Male</td>
<td>6 y</td>
<td>Down Syndrome</td>
</tr>
</tbody>
</table>
TB QITA with its vision of educating children to grow and to develop naturally provides a child-friendly curriculum. All of the learning activities were able to give maximum opportunity for children to move and explore their environment. Thus, the learning activities used several active learning methods, including exploring and experimenting outdoor, with natural media, and also in nature.

Children have five natural traits, namely full of amazement, high imagination, curiosity, high urge to ask questions, and being active with their full energy [15]. This is in line with the basic theory of cognitive development [16] that children are strong and motivated learners. This should be the basic knowledge for early childhood educators to be aware and able to present activities that can accommodate the nature of a child's development in harmony.

The teachers believe that every child has his or her own potential, and no exception for students with special needs. In addition, what educators must do is give children the opportunity to explore their potential in a real environment using all of their senses.

Likewise, the basic principle in the recent curriculum named, Kurikulum 2013 [17], that educational institution must emphasize meaningful learning activities through a scientific approach that allows children to observe, to use reasoning and logical thinking skills, to provide opportunities for children to participate directly in their environment and to discover new knowledge through exploring and experimenting, then to engage in active interaction and communication.

Another principle that is in line is the principle of Developmentally Appropriate Practice (DAP). The DAP principle emphasizes educators to fully realize that early childhood is unique. The application of learning must be able to accommodate and to facilitate the unique and different developmental needs of each child. Surely, this principle is also applied to early childhood with special needs [18].

In TB QITA, there are 5 centers, namely a center of preparation, a center of imagination, a center of design and creativity, a center of exploration, and a center for art and culture. The following is an overview of the plan for implementing daily learning (RPPH) which is implemented every Monday to Friday.

**Table 2. The RPPH / The Agenda of Learning Activities**

<table>
<thead>
<tr>
<th>TIMES</th>
<th>ACTIVITIES</th>
<th>SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>07.00-08.00</td>
<td>Morning activity: morning journal, free drawing, reading habit, recitation, phonics.</td>
<td>Outdoor</td>
</tr>
<tr>
<td>08.00-08.15</td>
<td>Conditioning</td>
<td>-</td>
</tr>
<tr>
<td>08.00-09.15</td>
<td>Gathering / classical, gymnastics (Tuesday &amp; Thursday), Duha Prayer (Monday and Wednesday)</td>
<td>Indoor, except for outdoor exercise</td>
</tr>
<tr>
<td>09.15-11.00</td>
<td>Core activities, playing indoors, and outdoor play activities.</td>
<td>Indoor and Outdoor</td>
</tr>
<tr>
<td>11.00-11.30</td>
<td>Meal, toothbrush and preparation to go home (praying and shaking hands)</td>
<td>Indoor and outdoor for toothbrushes</td>
</tr>
</tbody>
</table>

On Fridays, core activities are still carried out in a shorter duration then they return home earlier at 11.00. On Saturdays, there is no implementation of the central RPPH, or what is usually called a Special Day. Special day activities on Saturdays are focused on mastering children's life skills through several activities that are alternately done such as cooking,
farming, community service activities in the schoolyard (such as coloring rocks, watering the schoolyard, collecting and disposing of dry leaf litter, etc.), outbound activities carried out in the environment around the school, riverbanks, role-playing activities in the schoolyard, etc. All activities on Saturdays are carried out almost completely outside the room (outdoor). The children and teachers carry out activities indoors only to prepare equipment or pray and opening activities at the beginning. Joint prayer activities can be even done outdoors.

The media used in learning activities at TB QITA is also commonly found and used in other preschools, for instance, various game tools (brick, block, Lego, and puzzle), various kinds of role-playing tools (dolls, miniature cooking tools, and miniature animals and vehicles), children's worksheets made by the teacher, and various reading cards and numbers.

The unique aspect of this school compared with many other preschools is the outdoor activities that are practiced a lot every day. The teachers of the school said that in general, at least 60% of outdoor activities are daily applied, through exploring activities, observing the natural surroundings, as well as doing experiments. Outdoor activities are carried out by schools to accommodate the natural development of children who tend to be active and like to move and to facilitate the absorption of richer information through natural phenomena and real events in the surrounding environment.

The media used in outdoor activities is more related to sensory motor activities, namely water, soil, rocks or gravel, grass and dry leaves, and flour or other sensory motor media. The teacher spreads a sitting mat, or arranges tables and chairs outside the room, under a big tree, and the children start to do learning activities. Storytelling activities are also often done outdoors. This is a challenge for the teachers because some very active children tend to be easily distracted.

Furthermore, children’s concentration seems easier to be controlled outside the room during exploration and experimentation activities with natural materials. Exploration activities are carried out by looking for pebbles in groups or pairs, then counting with the stones, giving numbers, or making collages from collected stones. There are some other exploratory activities, such as finding insects around the school, looking for the plants they like the most, and then telling about them or applying them freely in pictures.

Classrooms in TB QITA are a bit different from preschools in general around Banyumas Regency. The classes at TB QITA are made in semi-open and semi-permanent, with a combination of walls and woven bamboo for the walls, wide windows, and doors that are always open, allowing the circulation of sunlight and air to come in and out freely. This is also intended so that children feel more free and comfortable because they are not confined to a closed room.

### 3.2 Impacts on Children with Special Needs

The method used in collecting research data was done by observation and interview. The improvement of child development is seen in five aspects, namely cognitive abilities, language skills, physical motor abilities (gross and fine motor skills), social-emotional abilities, and religious moral values. These aspects are shown through a checklist of child development compiled by researchers based on the level of achievement of early-aged children's development (ages 4-6 years) [17][19][20].

The subjects of this study were 3 children with developmental disabilities or special needs in TB QITA, respectively AHM, MRAF, and AAZ. The data collection techniques used were observation and structured interviews on the subject, teachers, and parents as additional data. The three research subjects have obtained nature-based learning activities at TB QITA
for 1 semester, from July 2018 to July 2019. In April 2019 nature-based learning activities were carried out online due to the global COVID19 outbreak.

In the new academic year in July 2019, online learning activities are combined with independent therapy activities with media and outdoor settings, which are carried out by parents every day at home. Teachers and researchers provide training to parents, as well as measurements which are carried out online every Saturday. Individual therapy activities are given directly to children with special needs who come to the school twice a week.

As seen from the facts of the three research subjects, parents and teachers felt that there was a significant positive difference compared to when these kids first arrived at school. The three subjects showed more adequate positive emotional expressions (expressions of joy, great pleasure, enthusiasm). At the beginning of their coming to the school, MRAF and AAZ were still showing quite volatile emotional conditions, accompanied by several temper tantrums. Currently, the condition of the two subjects is much more conditioned and can be soothed during emotional moments. Another symptom that seems typical of both subjects is their behavior of ignorance or not responding to stimulation. Surprisingly, they have become much more responsive now.

From the beginning, AHM did not show emotional symptoms that were too heavy and seldom experienced temper tantrums. In the beginning, he was more likely to be indifferent. Now he is more able to express his feelings and ideas even though in a sentence structure that is still not clearly understood (improper articulation). Impulsivity can be seen from AHM. He will tend to do what he wants without considering his own or other people’s danger. He is now much more cooperative and able to follow the instructions given.

The positive development shown by the three subjects above could be a natural condition of development that increases with the age of the child [21]. Early childhood growth and development runs dynamically with children’s age from birth to adulthood. However, this certainly cannot be separated from the learning process or stimulation provided by the immediate environment, including the school [22].

The learning process provided by teachers in schools through nature-based activities that condition children to feel comfortable, safe, relaxed, and energized, of course, provides a positive role for biological growth and provides children with abilities new. Stimulation given to children that makes them feel happy is a pivotal factor for the brain and nerve system to grow optimally [22][24].

Furthermore, parents stated that they felt secure and comfortable while their children were at school. At school, children do not seem to feel constrained due to various daily activities and some activities that provide flexibility for children to move and discover new things. Children also appear enthusiastic when going to school. It can be seen from their positive emotional expressions such as smiling, expressing their cheerful and enthusiastic feeling. One of the participants, AHM, could even say "I like school", "I like friends", "I like toys and teachers at school".

The following is an illustration of the differences between the participants’ conditions before and after the nature-based learning activities as a group for approximately 2 semesters. As stated before, this treatment was combined with individual therapy together with teachers who focused on the ability to follow instructions.
Table 3. The Stage of Basal, Treatment, and Follow-up

<table>
<thead>
<tr>
<th>Name</th>
<th>Basal</th>
<th>Treatment</th>
<th>Follow-Up</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHM</td>
<td>No tantrums</td>
<td>No tantrums</td>
<td>No tantrums</td>
</tr>
<tr>
<td></td>
<td>Hitting his own head when angry</td>
<td>No more hitting his own head when angry</td>
<td>No more hitting his own head when angry</td>
</tr>
<tr>
<td></td>
<td>Frequent Repetitive Movements</td>
<td>Occasional movements appear and stop when reminded several times</td>
<td>Repetitive movements appear with little intensity (especially appear when an activity is pausing) and stop when reminded.</td>
</tr>
<tr>
<td></td>
<td>Not able to focus</td>
<td>Started to focus, and willing to follow orders</td>
<td>Able to be more focused, willing to follow orders, and more cooperative</td>
</tr>
<tr>
<td>MRAF</td>
<td>Tantrums with typical behavior of pulling clothes, sitting down and refusing to walk, intensity almost every day</td>
<td>Tantrums with the same behavior, reduced intensity still in 1 week</td>
<td>No tantrums</td>
</tr>
<tr>
<td></td>
<td>Not able to focus</td>
<td>Starting to be able to focus</td>
<td>Able to focus</td>
</tr>
<tr>
<td></td>
<td>Not understanding commands</td>
<td>Beginning to understand commands</td>
<td>Understand commands</td>
</tr>
<tr>
<td></td>
<td>Not yet uttering sound or words</td>
<td>Starting to appear minimal sounds or words</td>
<td>Sounds and words have come out (the word “bola” is clearly uttered, other words are not clear), and trying to make voices and words enthusiastically.</td>
</tr>
<tr>
<td>AAZ</td>
<td>No tantrums</td>
<td>No tantrums</td>
<td>No tantrums</td>
</tr>
<tr>
<td></td>
<td>Emotional behavior appears frequently in everyday life</td>
<td>Emotional behavior starts to decrease</td>
<td>Emotional behavior still appears occasionally</td>
</tr>
<tr>
<td></td>
<td>Not understanding commands</td>
<td>Starting to understand commands</td>
<td>Able to understand commands</td>
</tr>
<tr>
<td></td>
<td>Following his own wishes</td>
<td>Still following his own wishes, but also listening to instructions</td>
<td>Still following occasional his own desire, willing to listen to instructions, but still firm.</td>
</tr>
</tbody>
</table>

Based on the above description, in terms of quality, it appears that there was an improvement in psychological well-being in the three subjects. It was indicated by the decreasing expression of negative emotions, also by increasing the quality of positive emotional expressions. In addition, there was a significant difference in the attitudes and behavior of the three research subjects, in the current condition after the subject received stimulation of nature-based learning in TB QITA compared to before the subject entered the school. There was a general improvement in the quality of development.

In April 2020 due to the increasing COVID19 pandemic situation, the homeschooling policy was implemented. Online learning is then applied to all students including children with special needs. Even though the teacher had performed the learning activities in the online learning, they provided opportunities for students to participate actively and have interaction with the surrounding environment and nature around the house. However, the activities should be following the rules of physical distancing. As a result, this cannot run optimally like learning in normal times before the pandemic.

Therefore, the researchers collaborated with the school and carried out training and mentoring events for parents, as well as monitoring every Saturday on nature-based independent therapy that parents can provide to their sons and daughters at home easily and practically. Independent therapy is provided side by side with daily online learning activities, as well as therapy activities in schools that are carried out with the COVID19 procedure such
as ensuring that children, parents, and teachers and therapists are in good physical health, checking body temperature, maintaining body hygiene, especially hands and feet before and during the therapy, keeping distant as much as possible without decreasing the quality of therapy procedures.

Based on the results of measurements carried out on the three research subjects, when parents applied nature-based self-therapy at home, it appeared that adequate positive emotional expressions appeared in their positive expressions such as smiles, enthusiastic expressions, happy expressions, and calm movements. As long as the self-therapy is applied by the parents, the subjects are willing to follow the instructions given and the activities until it is finished.

The emergence of adequate positive emotional expression on the subject is due to the subject's attention and interest in the nature-based self-therapy process. Nature-based learning is given in the form of various outdoor exploration activities. It also provides an opportunity to all senses to come into contact with nature, especially water and land, makes the subject relaxed, but on the other hand, it inspires the nerves at the end of his senses to become more active, and it indirectly activates the work of the central nervous system [23]. In addition to the apparent positive emotional expressions, the subjects also showed an increase in developmental outcomes in several aspects, as presented in the following data.

**Table 4. Child Development Outcomes after Nature-based Self Therapy**

<table>
<thead>
<tr>
<th>ASPECT</th>
<th>DESCRIPTION</th>
<th>SUBJECTS</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>AHM</td>
<td>MRAF</td>
<td>AAZ</td>
<td>A</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Intelligence &amp;</td>
<td>Potential intelligence of individuals in groups of age, which is manifested</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Capability</td>
<td>in the ability to understand information</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language skills</td>
<td>Understanding instructions, and expressing thoughts through word</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Sensory Motor</td>
<td>Ability to move in a strong, flexible, and balanced muscle coordination</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Independence</td>
<td>Self-help in daily activities</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Emotion</td>
<td>Express feeling</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Social Relations</td>
<td>Build relationships with other people</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Concentration</td>
<td>Focus attention intensely and attentively</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Motivation &amp; Confidence</td>
<td>Confidence in the potential ability</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Information: * 1) Not yet developed; 2) Start to appear with limited frequency; 3) Development needs to be motivated, not adequate; 4) Sufficient Development, according to Age; 5) Good development, running optimally; 6) Very good development, skyrocketing above the average age ability. ** A = Month 1 (July), B = Month 2 (August)
MRAF has the delay problem in the overall developmental function (general developmental delay) caused by complex genetic problems. This problem has an impact on the delay of the subject in all aspects of its development, especially barriers to cognitive, psychomotor, language, and affection (social and emotional) development. In the baseline phase, MRAF has not been able to provide any response and based on its development milestones, it is equivalent to the development of children aged 1 year. It was amazing to find out that MRAF shows a positive response after stimulation, although it is inadequate.

AHM has problems with attention deficit and hyperactivity disorder / ADHD or in other languages is called attention deficit and hyperactivity disorders / ADHD. This disorder causes the subject to have 3 main symptoms, namely, difficulty concentrating, impulsivity, and excess energy which causes the subject to become hyperactive. The subject experienced a significant increase in ability, although the subject's condition did not experience delays or significant problems in the cognitive aspects, the subject experienced a significant increase especially in the subject's language skills and social-emotional abilities.

Down Syndrome experienced by AAZ has an impact on the deterioration of developmental functions, especially on the capacity of intelligence. Various abilities of the subjects developed late below the average ability. This subject experienced many positive changes after being given sensory activities playing in nature. The learning activities given to AAZ are focused on mastery of self-help and daily living activities. In the cognitive aspect, it appears that the subject is able to start absorbing the information around him, the response is good and quite adequate. The subject's psycho motor abilities experienced positive development. The strength and balance of the legs, hands, and body are getting better.

Based on the description above, it can be seen that TB QITA is one of a preschool implemented nature-based learning that was delivered side by side with individual education programs at school by teachers and at home by parents. The activities using nature as the setting and media of the treatment to the children in daily situations emphasized stimulation of the three main senses, namely tactile, vestibular, and proprioceptive.

Those three sensory systems are very important because they help interpret and respond to children's responses to the environment. The tactile system is the largest sensory system formed by receptors in the skin, which send information to the brain for light, touch, pain, temperature, and pressure stimuli. The vestibular system is located in the inner ear (semicircular canal) and detects movement and changes in head position. The vestibular system is the basis of muscle tone, balance, and bilateral coordination. The proprioceptive system is found in muscle fibers, tendons, and ligaments, which allows children to unconsciously know the position and movement of the body [23][24].

Ultimately, there are several pivotal elements in nature-based learning that affected significantly on the psychological well-being of subjects, as well as the increase of their developmental achievement, as follows:

1) Learning is carried out outside the room (outdoor) and in nature, thus it can provide flexibility for children to move and to explore.

2) Learning uses the media of various objects in nature with all the characters they have and the sensations they cause. This nature-based learning allows children to come into contact directly and feel various natural sensations such as heat, cold, the glare of the sun, gravel that makes the feet tickle or a little sore, grass that makes itchy or perhaps also soft and comfortable, water, soil, dew, and various objects in nature along with the sensations they cause.
3) Learning in nature provides an opportunity for all senses that children have to capture much diverse information so that it stimulates the central nerve to respond more actively. As a result, children can be more responsive.

4) Learning in nature allows for an atmosphere of peacefulness and serenity created by nature and various existing media. Even though the activities are carried out in interesting situations, they still make children calm, making it easier for them to be cooperative, comfortable, and secured.

5) Learning in nature is carried out by teachers who are able to facilitate appropriate and adequate learning activities and have good class mastery.

6) Learning in nature allows children to communicate with each other and interact with their peers more comfortably and freely.

4 Conclusion

This research was conducted during the 4 months period, starting from February to August 2020, in one of a preschool using nature as the setting and media of the learning activities. The nature-based learning gave a positive impact on the psychological well-being of children with special needs. The significant impact was indicated by the emergence of positive affection, rather than the negative emotion. The ability to express affection, and the emergence of the positive emotion increased adequately and more precisely. The implementation of nature-based learning gave a positive impact on the children's developmental milestone. Either parents or teachers agreed students felt comfortable with the setting of learning activities in nature. It made the children feel happier, it also could relieve the tension particularly between parents and children during activities. The ability of the children in many aspects of their development increased gradually, and it helps the children to explore their potential. The nature-based learning could be developed and applied widely in the community, based on the reason for its effectiveness, its accessible process and requirements.

References


Bioavailability of Nickel (Ni) in Spiked Soils by Sequential Extraction and Its Bioaccumulation in Basil (Ocimum Africanum L)

Nopja A.R¹, Asep Saefumillah², Askal Maimulyanti³
{nopjaar.ui@gmail.com¹, asep.saefumillah@sci.ui.ac.id², askal_m@yahoo.com³}

University of Indonesia¹², AKA Bogor Polytechnic³

Abstract. Soil samples are extracted by sequential extraction to assess metal speciation and its bioavailability, and each fraction will be tested with an AAS instrument. The bioavailability of spiked soil with Ni metal showed the most distribution detected in fraction 3 (bound to Fe and Mn Oxides) were percentage 38-58%. Basil (Ocimum Africanum L) plants, which will be the media for the mobilization study of heavy metals, then plant were wet destruction and detected by ICP-MS. Furthermore, the ability of Basil to absorb Nickel showed a higher accumulation detected in roots, followed by stems and leaves (C-roots>C-stems>C-leaves). And different concentrations, it is known that the higher the concentration of metal spiked into the soil, the higher the concentration of nickel-metal that can be absorbed and detected in soil and plants. So, Basil able to hyperaccumulator nickel but low, cause TF < 1 and BCF < 2.

Keywords: Bioavailability; Nickel; Plant; Soil; Sequential Extraction

1 Introduction

Heavy metals are a group of metal elements that are categorized as dangerous if they enter the body of living things. Metals such as mercury (Hg), chromium (Cr), nickel (Ni), zinc (Zn), cadmium (Cd), and lead (Pb) can be found in aquatic environments contaminated with waste [1]. Since they appear to bioaccumulate, heavy metals are toxic. Compared with the concentration of a chemical in the atmosphere, bioaccumulation means a rise in the concentration of a chemical in a biological organism over time. Nickel is used in a variety of commercial and industrial applications, such as: steel armor (stainless steel), copper shielding, battery industry, electronics, aircraft industrial applications, textile industry, gas-fired power generation turbines, strong magnet makers, manufacturing laboratory equipment nichrome), electric light wires, fat catalysts, agricultural fertilizers, and various other functions [2]. Plants are known to accumulate Nickel so that when consumed it is transferred to the human body. In small amounts, Nickel is an essential element, but when it is in too high a concentration it is harmful to human health. Large amounts of nickel exposure will have the consequence of a higher likelihood of developing lung cancer, nose cancer, laryngeal cancer, and prostate cancer.

Bioavailability of heavy metals (nickel) means that the absorption of heavy metals by plants is controlled by various soil and biological factors [3]. Many factors that influence the bioavailability of Ni in soil include soil pH, interaction with other metals, water holding capacity (WHC), cation exchange capacity (CEC), and organic matter (OM), pH (degree of
acidity) is used to express the level of acidity or alkalinity of a solution. The water holding capacity represents the greatest amount of water the soil can hold against gravitational attraction. Cation Exchange Capacity is the total number of cations that can be exchanged on the colloid surface which is negatively charged which is closely related to the availability of nutrients for plants and is an indicator of soil fertility. The amount CEC is influenced by soil texture, clay mineral type, and material content. Total organic carbon (TOC) is the amount of carbon bound in the form of organic material. This soil organic material can be obtained from decomposing plants and animals, microorganisms, and soil biota. The absorption of a heavy metal by plants from heavily polluted soil is less than the absorption from lightly polluted soil. This is related to a higher pH increase by more pollutants and in line with the higher KPK, so that soil absorption becomes stronger.

Many researches related to metal speciation have been carried out, however, especially for metals in the soil, they are still limited [4]. The research was carried out using a gradual extraction method to determine the distribution and mobility of heavy metals in different soil compartments, in order to assess the consistency of urban and suburban soils irrigated by metal-enriched water in the city of Fez (Morocco). It can be seen from the results of these studies that Cr, Cu, Ni and Pb are mostly related to the residual fraction, so they only move a little in theory; while Zn is basically related to the metal oxide fraction and interchangeable phase in the soil, so Zn has the potential to move. Conducted a study to determine the chemical speciation of three heavy metals using a stepwise extraction method adapted from the protocol suggested by European Standards (SM&T). The objective of this study was to determine the geochemical speciation of four metal boundaries: acid soluble, reducible, oxidized and residual, and to evaluate their effect on Banten Bay, Indonesia, sediments. The findings showed that in the residual fraction of the overall concentration, the proportion of copper (45.90-83.75 percent), nickel (18.28-65.66 percent), and zinc (30.45-79.51 percent) was mainly accumulated [5].

The urgency of this study is to focus on the problem of the risk of heavy metal contamination on agricultural land using polluted river water as irrigation. The risk of heavy metal contamination that accumulates in the soil and even gets absorbed into food plants (in this study is Basil) is the research concentration. A method that is effective, simple, and can provide information on the speciation of accumulated metal is also considered, so a sequential extraction method is chosen. In this study Ocimum Africanum L used to know ability as a Ni metal hyperaccumulator.

2 Material and Methods

2.1 Chemical

Nickel (II) sulphate hexahydrate (NiSO4. 6H2O) (Meck), Pottasium chloride (Meck), Nitric acid 65% (Meck), Perchloric acid (Meck), Calcium Chloride (Meck), Hydrochloric Acid (Meck), Hydroxylammonium Chloride (Meck), Sodium Acetate (Meck), Acetic Acid (Meck), Hydrogen Peroxide (Meck), Aqua Regia (HCl : HNO3, 3:1), and Aquadest.

2.2 Sampling Collected

Soil samples were collected from farm in Rawa Kalong Village, Grogol, Depok, West Java in January 2020. Based on the observation of coordinate points through the Google Maps
application, this location is at position 6°22'41"S 106°47'30"E (latitude position 6 degrees 22 minutes 41 seconds and longitude position 106 degrees 47 minutes 30 seconds). The irrigation source used is river water around the rice fields. Soil is taken that is with a height of 0-30 cm from the ground.

2.3 Characterization of Soil

Characterization of original soil samples consisting of measurement of water content, pH, total organic carbon (TOC), cation exchange capacity (CEC), soil texture, water holding capacity (WHC) and total Ni and Zn metals.

2.4 Sequential Extraction

In soils, the presence of metals can take different forms and bonds, including free ions and carbonate bonds, in which the metal in this form is considered a very unstable metal, such that it can be easily released into the waters and easily consumed by animals. When the metal binds to Fe / Mn oxide, the reduced form is (reducible). Metals are derived from this method of binding with organic matter and sulfides in an oxidizable form (oxidizable). In the form of a powerful bond with the mineral crystal structure in the soil, the residual form is meta [6]. The choice of reagent is related to the metal in the environment, the chemical properties of the metal, the matrix content of the sample to be extracted and the analytical technical availability in the laboratory. The procedure used for the five fractions based on Tessier, 1979 [7]. In this study, original (non-spike) soil samples and metal-spiked soil samples were used. In metal-spike soils, the spike dose is mg kg⁻¹ of metal soil (ppm of soil).

2.5 Plant growth experiment

In this study, Basil will be planted in soil that has been controlled (Nc) and contaminated by Ni with concentrations of 50 (N-50), 200 (N-200) and 400 (N-400) ppm of soil. Air-dry soil samples that were clean from the rest of the roots, gravel and fine (2 mm) were weighed 200 g for each pot. Then the Ni and Zn solutions are added according to the desired treatment, then incubated for 20 days before planting to allow the metal to be evenly absorbed in the soil. In addition, non-spike ground is also used as control. Basil plant seeds are sown first in trays containing non-spike soil, before transplanting them into pots, transferring is done until the seeds grow leaves and are strong enough for 7-10 days. After that, planting 2 basil for each pot is carried out. Existing plants are maintained until vegetative growth for 5 weeks at a temperature of 30-32°C with daily sun exposure ± 10 hours, during growth, ± 20mL of demineralized water is watered. At harvest time the plants are cut about 1 cm above the ground using scissors. After that the plants are rinsed several times with demineralized water to remove soil particles. Subsequently, it was heated at 80°C for ± 2 days until the water content remained. To calculate the metal content absorbed in the basil plant, the Basil is digested using the wet digestion method.

2.6 Sample Pre-treatment (Wet aghig)

As much as possible (g) of the dried basil sample is divided into 3 parts, namely the roots, stems and leaves, which have previously been crushed are put into a small beaker and weighed
respectively, then added with 5 mL of concentrated HNO₃ and let stand overnight. After that, heat it in a hotplate at 100°C for 1 hour 30 minutes, then cool it. Then added 5 ml of concentrated HNO₃ and 1 mL of 70% HClO₄. Reheat (± 130°C) for 1 hour, the temperature is increased again to 150°C for 2 hours 30 minutes until the solution evaporates (yellow vapor runs out). After that, the temperature was increased to 170°C for 1 hour, and 200°C for 1 hour until white steam was formed and the volume was reduced (2-3 mL). Filter the solution into a 25 mL flask using filter paper. Wipe and dilute the filter paper to mark the boundaries. Then the solution is ready to be analyzed to determine the metal content with AAS.

2.7 Instrumental & Data Analysis

The instrument used for initial characterization and sequential extraction was Atomic Absorption Spectrophotometry (AAS) type Shimadzu AA-6300, while for plant analysis using ICP-MS type Nex Ion 300 Perkin Elmer. The detection limits of nickel heavy metal in AAS and ICP-MS were 0.02mg / L and 0.0037µg / mL respectively. In order to determine the capacity of Acium Africanum, the Translocation Factor was determined and this ratio is an indicator of the plant's ability to translocate heavy metal from the roots to the aerial parts of the plant. TF values <1 are used to denote the accumulated heavy metal in plants and the lager contained in plant roots [8].

\[
TF = \frac{\text{Heavy metal concentration in steam or leaf}}{\text{Heavy metal concentration in root}}
\]

The amount of heavy metal from soil absorbed by plants was determined by the Bioconcentration Factor (BCF). Calculated by using the formula [9] :

\[
BCF = \frac{\text{Metal concentration in whole-plant tissue}}{\text{Original concentration of metal in soil}}
\]

The BCF values > 2 were considered to be high values for the capacity of the plant to accumulate a specific metal in relation to its soil concentration [10].

Using Windows Excel, data on this analysis has been tabulated and is present in the table and map.

3 Results and Discussions

3.1 Initial Soil Characterization

The results of in situ measurement of the physical properties of soil samples which include sample water content, soil texture, soil pH (pH H₂O and pH KCl), organic carbon, water holding capacity (WHC), and cation exchange capacity (CEC) were obtained as follows:

<table>
<thead>
<tr>
<th>Table 1. Soil Characterization Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parameter (Unit)</strong></td>
</tr>
<tr>
<td>Ground water content (%)</td>
</tr>
<tr>
<td>pH H₂O</td>
</tr>
<tr>
<td>pH KCl</td>
</tr>
<tr>
<td>Soil texture (%)</td>
</tr>
<tr>
<td>- Dust</td>
</tr>
</tbody>
</table>
- Sand: 37.33
- Clay: 61.33

Organic Carbon Content (%): 1.44
Water Holding Capacity (%): 82
Cation Exchange Capacity (C mol+/kg): 20.98

Soil characterization experiments in the table above were carried out to determine the initial chemical properties of the sample before being given treatment. The water resistance capacity can reach 82% or 82 mL / 100g of soil and water content of 19.43%. The composition of the soil sample consisted of 1.33% dust textured, 37.33% sand textured and 61.33% clay textured. This shows that the soil sample is classified as fine texture. Soil texture has a relationship with water holding power and nutrient availability. According to Hardjowigeno [11], water is contained in the soil because it is absorbed (retained) by the soil mass, is held back by an impermeable layer, or because of poor drainage conditions. Soil samples are slightly acidic containing a pH of 4.4 H₂O and a pH of 3.7 KCl. pH of KCl is the potential acidity obtained from the interaction of KCl with organic compounds in the soil. The soil sample used has a cation exchange capacity (CEC) of 20.98 cmol+/kg. This value is large enough for the soil to exchange cations. Soil acidity can cause problems such as decreasing nutrient availability for plants, increasing the impact of toxic elements and decreasing crop yields. The sample's organic C content was 1.44%. Organic material from the soil is 1.44% of the total soil weight.

3.2 Mobility and bioavailability of Ni in soils

Ni metals were spiked into 10g soil with different concentrations of 100% WHC. Then 2g each is taken and put into a centrifuge tube for gradual extraction consisting of 5 fractions. The reagent used was adjusted by the Teasser method and modified with the reagent from the half-reaction method [12].

The control soil (untreated) obtained the residual (F5) fractions below the detection limit, while at most in Fe/Mn oxide (F3) and organic matter (F4) fractions, respectively. In Ni metal, the species binds to Fe/Mn oxide is the fraction that is mostly found in Ni metal amounting to 9-117 ± 0.03-0.45 mg kg⁻¹ (Fig.1). Next is the organic matter fraction. This is indeed common, since oxides account for a large proportion of the total soil weight [13]. Fe-Mn Oxide is the most important metal adsorbent in the soil.
Fig. 2. The partitioning of Ni among steps in sequential extraction of sample soil

Fig. 2 shows the extracted percentages of Ni in all steps of the extraction procedures of soil sample. The highest percentages of Nickel in Fe-Mn Oxide fractions were found to be in range 38-58%. The higher the nickel concentration in the spike, the higher the bioavailability of Nickel in the soil for any fraction or total Nickel in the soil.

3.3 Accumulation of Ni from soil to Basil

After each crop was harvested at a certain time, namely the 24-30th day for control soil and Ni spike. Samples were wet digestion with concentrated acid and analyzed using ICP-MS.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Biomass (gDW)</th>
<th>Concentration (mg kg⁻¹)</th>
<th>Accumulation (μg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nc</td>
<td>0.3270</td>
<td>LLD</td>
<td>LLD</td>
</tr>
<tr>
<td>N-50</td>
<td>0.3140</td>
<td>0.4191</td>
<td>0.1316</td>
</tr>
<tr>
<td>N-200</td>
<td>0.0930</td>
<td>5.2667</td>
<td>0.4898</td>
</tr>
<tr>
<td>N-400</td>
<td>0.0300</td>
<td>23.6200</td>
<td>0.7086</td>
</tr>
</tbody>
</table>

To determine biomass and nickel accumulation, leaf concentrations were used. Table 2 indicates the concentration and aggregation in the soil culture of plant leaves at various Ni concentrations. The accumulation of Ni in leaves increased with rising levels of Ni spikes. And with increasing solution concentrations of Ni, leaf biomass decreased. The highest accumulation of Ni in leaves was 0.7086 μg at the 400 mg kg⁻¹ Ni spike concentration.
From the results of the ICP-MS data obtained, it was found that the Ni metal was mostly in the roots, stems, and leaves. The highest Ni concentration and accumulation in root were 1.58 mg.kg\(^{-1}\) (Fig.3). The results show that Ocimum Africanum Lour has a low potential for biomass and Ni-accumulation in soil that is contaminated by heavy metals.

**Table 3. Translocation Factor (TF) and Bioaccumulation Factor (BCF)**

<table>
<thead>
<tr>
<th>Ni spike</th>
<th>TF</th>
<th>BCF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Root-Stem</td>
<td>Root-Leaf</td>
</tr>
<tr>
<td>50 mg kg(^{-1})</td>
<td>0.3131</td>
<td>0.2653</td>
</tr>
</tbody>
</table>

The ability to accumulate high concentrations of metal or metalloids in the aboveground biomass is a translocation factor (TF) and bioconcentration factor (BCF) that provide two characteristics of hyperaccumulator plates. Usually, the translocation factor (TF) for hyperaccumulator plants is > 1. In Ocimum Africanum L, translocation factors for Ni were found to be in the range of 0.2-0.3 (Table 3). Bioaccumulator factor of Ni heavy metals in basil show BCF < 2 in all parts of plant, which is equal to 0.008-0.03. The mechanism by which plants acquire metal ions in the soil is usually influenced by the three basic processes of mass flow, diffusion, and root interception [14].

Based on the research results, it can be seen that the increase in nickel concentration spiked in the soil is directly proportional to the total bioavailability of heavy metal nickel in the soil and plant bioaccumulation. Which means that the higher the mg kg\(^{-1}\) of Nickel in the soil, the higher the bioavailability in the soil in the form of 5 fractions and its absorption in plant parts.
4 Conclusion

In order to determine the mobility and chemical types of Ni in soil samples, different selective chemical reagents and the five sequential extraction procedures used in this study were found to be useful. The concentration and percentages of Nickel up to 58% in Fe-Mn Oxide fractions. This makes nickel metal bioavailable and mobile from the soil to the basil plant. It was concluded that Ocimum Africanum L plant showed TF and BCF value low hyperaccumulator, but ocimum Africanum potential as Nickel (Ni) bioaccumulators.

Acknowledgments. This study was funded by Kementerian Riset dan Teknologi-Simblitabmas 2.0 period 2020 with contract no. NKB-486/UN2.RST/HKP.05.00/2020.

Reference

Internet of Things for Smart Future Science Laboratory in Middle School: A Literature Review

N F Kusuma¹, J Ikhsan², A Hujatulatif³, K Huda¹
{nurulfajrani.2019@student.uny.ac.id}


Abstract. Technology is urgently needed in the era of education 4.0 when technology and human are straight to bring through the new odds of multimedia and technology. The 21st century education in the digital literacy era requires students to able for using the multimedia technology. The recently of the new technology that are start to be widely is The Internet of Things (IoT). The technology concept that can expand using of internet connectivity by automatically connecting us to objects around us called IoT. IoT connecting us by censoring object. The IoT has commenced to broadly used and discussed in any fields such as education field, health field, architecture field, etc. Smart homes, smart cities, smart rooms, smart libraries, etc. also take advantage of IoT technology to facilitate their work. The reasearch using a literature review method. The aims of this paper is to see the benefits and the framework of IoT technology when it applied to a smart laboratory in middle school level.

Keywords: Internet of Things (IoT), Middle school, Science Laboratory, Smart Laboratory.

1 Introduction

Education 4.0 responds to what the Industry Revolution 4.0 needed when the technology and human are straight to bring through the recent odds of multimedia and technology. The teacher needs to learn and equip themselves with digital tools to meet Gen Z learners [10]. The 21st century is the digital era's literacy, where educators must be able to use multimedia technology such as learning methods through animation from scientific skill and scientific concept [22]. Educational Technology and Mobile Learning say that educators can use many digital tools to make learning more enjoyable. There are so many technologies that can operate as learning media in this 4.0 era [7]. professional life to social relationships covered on the internet has changed drastically in our experience interactions that move among humans on a virtual level in several contexts. IoT has stuff to add a recent process of dimension by sustaining communication between smart goods, thus leading to a vision of communication “anywhere, any media, anything, anytime”[4].

Teachers are required continuously to a learning method that is more interactive and innovative. Learning breakthroughs combine audio, script, music, images, videos, or animated images to unity that bolster each other to achieve learning objectives that can create a sense of joy during the teaching and learning process. it can work up student motivation during the teaching and learning process so that maximum learning objectives obtained [18]. IoT is a
technology that is currently growing in the current era of 4.0. IoT technology is developing
global-based information. IoT is the recent model that is summarily increasing in the modern
wireless telecommunications scenario. IoT basic concept is the spread of attendance around us
in various things or objects - such as sensors, cell phones RFID tags, or actuators. IoT past a
unique addressing scheme. It can cooperate with their neighbors and interact with each other
to achieve common goals. [8]. IoT is the physical system objects that integrated seamlessly
into IT networks, and the items can be active participants in business processes. The IT service
is available to connect with this 'smart object' by the internet, and they're asking for the status
and information related to it, taking into account security and privacy concerns. [3].

IoT can use to create an intelligent system. Smart city, smart room, smart library, etc. is
an example of using IoT. In the education system, IoT has also widely used, one of that is the
use of a smart classroom. One of the science facilities that must operate in middle school is a
science laboratory. So far, the use of laboratories has mostly ignored. According to Rahman &
Sumenep (2017), teachers are reluctant to use laboratories because many laboratory facilities
and infrastructure are damaged, this is due to lack of common control, and damaged
equipment is immediately not handled.

Besides, according to Putu Subamia (2015), there are several obstacles faced by schools
in implementing laboratory management, namely: limited space and laboratory facilities,
limited laboratory tools and materials, unavailability of laboratory staff, there's no SOP for
laboratory management, inability teachers manage to learn following the availability of
sufficient time, psychological barriers for teachers who are not satisfied if they don't lecture
much during learning, there is no guarantee of safety and health of laboratory workers, and
limited operational support funds.

IoT can be a solution for teachers in controlling all student activities in the laboratory.
Laboratory facilities and infrastructure can be maintained periodically, even remotely using
IoT technology. In this paper, we will provide a solution to the use of IoT in making a smart
science laboratory in middle school. The aims of this paper is to see the benefits and the
framework of IoT technology when it applied to a smart laboratory in middle school level.

2 Methods

The methods of this paper using a literature review. This paper is began by collecting the
articles from google scholar and some books which talked about the basic of the Internet of
Things, the uses of IoT, benefit, and the ideal standard of laboratory in middle school. The
keyword in google scholar is a Internet of things, Middle school, and science laboratory. This
paper writing by read the discussion part of the collecting articles and see the research paper of
using IoT in many field.

3 Results and Discussion

3.1. The Ideal Standard of Science Laboratory in Middle School

Science laboratory has a direct effect on students' academic attitudes and performance
according to the learning interaction theory. It generally believed that continuous practice
leads to proficiency in what students learn during classroom teaching. The involvement of
students in laboratory activities has shown a benefit on student achievement in the science
field. In laboratory activities, students work on questions, problems, or hypotheses
individually or in small groups. Laboratory activities are a way that sustain students to learn with concept and at the same time, be involved in the process of constructing learning by doing science. [13]

The science laboratory in middle school has National Standards regulated by Permendiknas No. 24 of 2007 in which the science laboratory functions as a place for science practice activities that require special equipment. The special equipment referred to is Science laboratory has a direct effect on students’ academic attitudes and performance according to the learning interaction theory. It generally believed that continuous practice leads to proficiency in what students learn during classroom teaching. The involvement of students in laboratory activities has shown benefit on student achievement in the science field. The Science Tools, which is a set of props needed to carry out science experiments [5]. A good layout in the science laboratory at middle school level has: 1) entrance, 2) exit, 3) emergency door, 4) preparation room, 5) equipment room, 6) task room, 7) storage room, 8) staff room, 9) workroom, 10) warehouse room, 11) glass cabinet, 12) tool cabinet optics, 13) doors, 14) windows, 15) fans, 16) and air conditioners for specific devices that require air conditioning [14].

The use of science laboratory space and tools must also be considered safe and comfortable for educators and students. The excellent management of science laboratories, according to the Development of the Directorate of Middle Schools [14], has the following characteristics:

- Practical is equipment that supports the improvement of the quality of the learning process or practicum;
- Efficient is that the equipment setting does not waste energy and costs.
- Healthy and safe are lightings, ventilation, sanitation, clean water, work safety and the environment all meet the requirements.
- Equipment/facilities are always ready to use and safe, meaning that all equipment/facilities are protected from damage, congestion, and protect from loss
- All laboratory activities are easily controlled, namely with good administration, clear information visualization and straightforward programs
- Fulfilling psychological needs are visually attractive, pleasant, good working climate and adequate physical and mental well-being.

Some of the location selection issues that are important for the environmental aspects, safety and health of the laboratory building be made up of the following [6]:

- Capacity and availability of significant requirement at the location;
- Access to vehicles and services to location and in location;
- Security and safety facility;
- Circulation of walking people to the location and in location;
- Subsurface conditions affecting the building structure and drainage site;
- Landscape features and surrounding buildings that have and impact the quality of air; supply and the spread of waste of the laboratory building;
- Contamination of water or soil on-site due to using laboratory previously.

3.2. The Ideal Standard of Science Laboratory in Middle School

Internet of Things (IoT) is a construct which aims to expand the use of internet connectivity widely, where we can connect with various objects that are around us. IoT is an IT revolution that presents the future of communication and multimedia, and its evolution
requires a support of innovative technology. [21]. IoT reduces human interference by introducing a device to device. The application of IoT in a smart laboratory can be very beneficial. We can monitor the energy and control equipment in the laboratory. Total energy consumption can reduce by using the IoT system. Where, in a whole year energy use can reduce by 30% by using a smart laboratory system [15]. IoT technology removes the limitations of physical attendance and expands access to any educational resource such as teachers, any tools and anywhere that facilitates E-learning efficiently. The IoT promises a necessary effect on the learning process in higher education by offering students, and teachers access to global resources and possibilities [1].

As the recent network connects information from company assets, operating environment, or the products, IoT can improve data and analysis, that can significantly enhance decision making. Some association begin to apply the applications in the spot planned, while general and demandingly apply still in experimental or the conceptual stages [11].

IoT has classified into three areas; these are[2]:
- A human with human,
- Human with things
- Object with an object, communication via the internet

Recently, RFID is appeared as the essential IT for changing a wide level of applications, including supply anti-counterfeiting, retail, chain management, aircraft maintenance, healthcare and baggage handling. It also signs the appearance of an expand cheaply and highly useful computer that will have a dramatic impact on society, individuals, and organizations [19].

According to Weber & Weber [24], there are various kinds of IoT techniques in connecting one object to another:

- **RFID (Radio Frequency Identification)**
  RFID is the system that can use to track and find assets automatically via waves of wireless radio. In common, this system consists of two-part, namely a transponder as a carrier of information, and the reader, it is a registration device which is reading a transponder information.

- **EPC (Electronic Product Code)**
  A unique number encoded on the RFID tag is called EPC. EPC made up of a header that assigns a type of EPC and how to read the other parts of the EPC. Usually, the EPC is in the form of a serial number.

- **ONS (Object Naming Service)**
  A service that contains a service address where each available service contains EPC data is ONS. Apart from storing all data about RFID chip/tag, the transmission of data thru servers distributed the internet can achieve through cross-linking via the ONS. ONS can also work as a core for computing throughout, allowing intelligent surrounding to admit and classify objects and get data from the internet to aid their adaptive functionality.

- **EPC Discovery Service**
  EPC Discovery Service is a system which looks for EPC related data, but it isn’t like ONS. The EPC contains not only pointers for specifying the original EPC code, but also for any code.

- **Graphic Overview**
RFID is a considered automatic identification method; it believed by general people to be unity about the rifest IT in history. RFID is the foundation on retrieval of data using devices and remote storage and called RFID chips/tags or RFID carriers. The technology of Automated identification, such as Auto-ID operations based on RFID technology, is crucial assets as record systems for two reasons. Firstly, the clarity provided by this technology recognizes accurate knowledge of index levels by reducing the difference between index records and physical record. Second, the RFID system can restrict or decrease the causes of error. The profits of applying RFID technology involve reduced workforce, simplification about business processes and reduced inventory inaccuracies [20].

Apart from RFID, WSN (Wireless Sensor Networks) also use as the necessary technology of IoT which adopts intelligent, interconnected sensors to monitor transmitting data to the central site where the data obtained does collect and can be further processed. The uses of WSN include disaster management, environmental and environment monitoring, health care applications, and battlefield monitoring. Near Field Communication (NFC) is also frequently used recently, Bluetooth, universal mobile accessibility (hotspot, WiFi, cellular network), social networks and cloud computing, to support the IoT paradigm in infrastructure definition [9].

IoT system that mostly used in education are [2]:
- Digital smartboard
- interactive learning
- Educational applications for mobile and tablet devices
- E-books introduce the most helpful method to study
- Other training media such as Google Apps, which let learners and educators participate online
- Development of information
- Wireless door lock
- Study anytime and anyplace
- Take further measures of safety
- Heat sensor
- Participation tracking system

Third-party applications are various applications from wearable electronic devices that could grow the standard, including wearable sensor patches, augmented reality glasses and, smartwatches. It can extend significantly to use, comfortable to wear computing everywhere by the following link from data processing and transportation improvements, miniaturization
tools, and new series technologies such as energy gathering through vibration, light, and heat [20].

3.3. The Framework for Applying IoT in Smart Science Laboratory

IoT has begun to be used in various fields, including in the field of education, from using IoT to create a smart classroom to a smart laboratory. The following is a figure 2 of IoT application that can use to create a smart science laboratory for middle school level.

![Fig 2. IoT utilization area in intelligent smart science laboratory](image)

We must consider five key areas when utilizing IoT in an intelligent smart science laboratory in middle school level:

- Human-centred design: general analysis of the needs of the user, and the environment around them is the primary step for building an intelligent environment. It can make it practical for the teacher to control the development of the entire group of students while working in the lab at one time.
- Smart IT-based infrastructure: the foundation of intelligent learning is smart IT where wise IT is referred to as 'digital agents' and 'digital assistants'
- Digital and physical devices: every digital device (smart-device utilisation) with the device must intelligent combined with physical devices (smartpens, smart TVs, tablets, air conditioners, lamps, etc.)
- Workplace architecture: the architecture where students do all laboratory activities must pay attention to safety, cleanliness and occupational health.
- Method of work: a hybrid learning environment was created for the needs of students to work in a smart laboratory. Students' laboratory practice guides are available digitally so that they can easy monitored.
Either the achievements of a smart city are to implement and protection to their residents with safe. For achieving the plan, an intelligent pressure system required that can utilize to law enforcement, crime detection, and accident and natural disaster management. To collecting the information, many instruments have been produced, such as CCTV (closed-circuit television) cameras and traffic sensors. This information, accompany by analytical evaluations, include possible improvements in the quality of data managed by fire departments, police departments and hospitals [23].

Meanwhile, to make a smart laboratory requires smart sensors and systems to:

• Facilitate the collection of laboratory administrative data;
• Control the storage area for tools and materials;
• Control the sterilization of instruments and materials;
• Control security;
• Control laboratory cleanliness.

The IoT platform is essentially a software product, offering a complete set of independent application functionalities which is using to build IoT applications. The structure of each IoT platform could be the difference as providers concentrate on various features of the IoT technology mound and thus include a diverse set of functions in their contributions. So, there is no arrangement standard of the IoT platform, but there are various IoT platforms, which address particular needs and application domains[25].

The drawbacks about using IoT to create a smart system are: First, because the IoT production is in the forward steps of evolution, may be its too early for a thorough review of this division. The specific way and impact of the IoT economy are unclear. How the market develops may be, in fact, very different from the way of advised by the popular stage of movement in the modern startup. Secondly, there are obstacles to the immediate and everywhere adoption of IoT products and services for various excuse. Sensors are still expensive; battery life remains an issue; information transmission is not a light issue. Location data is uncertain, wireless coverage is not throughout, and in most cases, significant information currents cannot interpret directly. It is not simple to change the information stream becomes important real-time [20]

4 Conclusion

Internet of Things is a construct that can use to create an intelligent system. This smart system can help us in everyday life; this smart system can also help us in shaping an IT-based learning education 4.0. The creation of an IoT-based smart science laboratory in middle school can facilitate the teacher to controlling of all student activities in the laboratory and periodically controlling the facilities and infrastructure of the science laboratory easily anytime and anywhere. The framework of IoT has five keys, there are: (1) Human centre design; (2) Smart IT-Based; (3) Digital and physical device; (4) Workplace architecture; and (5) Method of work. So, by applying the IoT system to make a smart science laboratory in middle school level, it can controlling all over the activity in laboratory and make the facility in the laboratory will safe, hygiene, effective and efficient to use.

References


Analysis of the Problem Solving Ability of Mathematics Education Students Using the Trigonometry Module

Rahmatya Nurmeidina¹, Ahmad Lazwardi², Arif Ganda Nugroho³
{rahmatya.dina@gmail.com¹, lazwardiahmad@gmail.com², arifgnugroho@gmail.com³}

Universitas Muhammadiyah Banjarmasin, Jalan Gubernur H Syarkawi Barito Kuala

Abstract. This study aims to analyze students' problem-solving abilities in the mathematics education study program after learning using modules in the trigonometry course. This research is a qualitative descriptive study. The subjects in this study were students of mathematics education semester I of low, medium, and high ability. The data collection technique is a test using problem-solving questions, interviews, and documentation. The data analysis technique used document analysis techniques. Data analysis was carried out by collecting data, reducing data, presenting data, and finally drawing conclusions and verifying data. The result of this research is that the subject can understand the problem by identifying the information that appears on the issue and determining the method or formula used in solving the problem. After that, solve the trigonometric problems given and check the results of the answers that have been done. The trigonometric material provided in the problem-solving ability test is the size of the angle, trigonometry ratio, and trigonometric identity. Students still have difficulty completing proving trigonometric identities because students are still confused and also experienced misconceptions in trigonometric and algebraic properties to confirm this trigonometric identity.

Keywords: Problem solving ability, Trigonometry, Module

1 Introduction

Learning mathematics is not just learning to count, but students can also develop problem-solving skills. This is by the objectives of learning mathematics as stated in Permendiknas No. 22 of 2006, and mathematics lessons aim to make students have the ability to understand mathematical concepts, explain the relationship between images and apply concepts or algorithms, in a flexible, accurate, efficient and precise manner, in solving a problem. Therefore, problem-solving is an ability that a mathematics teacher must have to develop students' problem-solving skills during mathematics learning.

The problem-solving ability is Problem Solving according to Hendriana, H.; Rohaeti, EE, & Sumarmo, U [1] which is an essential ability in learning mathematics, helping individuals think analytically, learning mathematical problem solving, in essence, is learning to think, reason and apply the knowledge that is already owned, solving mathematical issues helps to think critically, creatively and develop other mathematical problem-solving skills. Polya [2] proposes four problem-solving principles that are interesting and ensure that the mathematical principles learned will be transferred as widely as possible.

Polya's technique is known as heuristics (serving to discover), namely strategies that can help problem-solving. The heuristics method is: a. Understand the problem by asking what is
unknown, what data is being given, what kind of problem conditions, and doing things like etching the image. b. Creating a completion plan (creating a mathematical model), such as finding the relationship between data and anonymous information. c. Solve problems by implementing a complete program and checking each step. d. Re-examine procedures and interpret solutions to issues (results) obtained. Problem-solving skills are essential for mathematics education students as prospective teachers. A teacher or future mathematics teacher is required to be able to design learning that can explore problem-solving [3].

Trigonometry is a basic introductory course in mathematics education programs because trigonometry is a subject taught in schools. Basic concepts are used in other issues such as algebra, complex functions, calculus (limits, derivatives, integrals), and geometry. Trigonometry is a topic that is difficult for teachers and students to understand [4]. The observations on students [5] who are taking trigonometry courses show that students still have difficulty working on trigonometric questions, especially questions that cannot be answered directly by using memorized concepts or problem-solving problems.

Problem-solving skills are one of the soft skills that must be answered—owned by students. Problem-solving skills can be trained by frequently solving math problem-solving problems. Besides, initial research shows that students still have difficulty solving trigonometric issues, especially in problem-solving topics. Besides that, students also experience misconceptions [6]. Based on the interview results, it was also found that students were not used to and motivated to work on problems with problem-solving abilities; they tended to give up first before trying to answer and preferred to do routine questions about understanding concepts only. In higher education, lecturers play an essential role in providing facilities or conditioning lectures with the right method, one of which is doing modules [7].

The learning module can make students easier to practice problems with problem-solving abilities independently. Research by [8] states that learning mathematics using modules is beneficial. Students give a positive response to learning using the Trigonometry module. Thus learning using modules can be used as a solution to develop students' problem-solving abilities. The learning objectives use modules to facilitate students' learning course material and develop problem-solving skills [9]. Furthermore, it will be seen how the description of the solving ability of mathematics education students after using the module. Thus, this study analyzes students' problem-solving skills in the mathematics education study program after learning using modules in the trigonometry course.

2. Method

This study aims to qualitatively explain the problem-solving abilities of mathematics education students after learning using modules. The subjects in this study were 6 first semester mathematics education students at the Muhammadiyah University of Banjarmasin who received trigonometry courses using modules. The data collection techniques were students answered 3 problems solving trigonometric problems, deep interview, and documentation of all data. The research instrument consisted of 3 problem-solving questions with the question material indicators as follows.

<table>
<thead>
<tr>
<th>NO</th>
<th>Question material indicators</th>
<th>Problem</th>
</tr>
</thead>
</table>
1. **Angle and their measure**
   Earth rotates to arrive at 1 complete rotation, taking 23 hours 56 minutes 4 seconds. What is the radian of the earth's rotation in 1 second?

2. **The Trigonometric Functions of an Acute Angle of a Right Triangle**
   A child stands 3 meters from the base of the tree. The child looks at the top of the coconut tree at an angle of 60°. How tall is the coconut tree, if the child is 160 cm tall? Draw a sketch of the illustration.

3. **The trigonometric identity.**
   Show that
   \[
   \frac{\sin^2 x \cos x + \sin^3 x}{\sin x \cos x} = \tan x \sec x
   \]

The data analysis technique used document analysis techniques. The results of the students' answers were analyzed based on 4 aspects of Polya's steps, namely understand the problem, creating a complete plan, develop a problem-solving plan, and re-check the problem-solving results. Data analysis was performed by collecting data, data reduction, data presentation, and finally drawing conclusions and data verification. Data mining was carried out in-depth, originating from 3 problems solving trigonometric problems. The trigonometric material given in the problem-solving ability test is the size of the angle, trigonometry ratio, and trigonometric identity.

**3. Results and Discussion**

The subject's problem-solving ability was analyzed through the tests given to them and reviewing the way they answered previous tests. Furthermore, based on the analysis of students' answers in doing the problem-solving ability test questions and interviews, the results obtained were reviewed based on 4 aspects of Polya's steps, namely understanding the problem, making a solution plan, compiling a problem-solving plan, and checking the results of problem-solving as follows.

**3.1. Understand the problem**

Fig. 1. Students write down information about the questions known and are asked for the first question.
Fig. 2. Students write down information about the questions known and are asked for the first question.

The subject can understand the problem by explaining what information is obtained from the situation. In the first and second questions, students generally write information about the questions with known and questioned techniques in full, such as in Figure 1 and Figure 2. However, some write down the story that is known as in Figure 3. Equations and formulas should be punctuated in the same way as ordinary text but with a space before the punctuation mark.

Fig. 3. Students write down information about questions directly, without being noticed and asked.

In the third question, because of the shape, the problem is proof of trigonometric identity. So that students only write down the form of identity and then immediately prove it.

3.2 Creating a completion plan

Students formulate plans or strategies to solve problems. In the first problem, students use the program to solve the problem by converting time to seconds, then solving the issue by comparing the angle's size. As shown in Figure 4. For the second problem, students first illustrate the problem and then get a strategy using a trigonometric ratio that matches the situation. Student answers can be seen in Figure 5.

* ubah waktu 1 putaran penuh ke detik

Fig. 4. Students write down problem-solving steps
In question number 3, students compile a problem-solving plan by writing down the steps to get to the trigonometric form they want to prove, as figure 6 shows.

### 3.3 Develop a problem-solving plan

Students carry out the problem-solving plan that has been designed. In implementing the program, it is known whether the program is correct to lead to a problem? If it is correct, then the final answer is also correct. Figure 7 shows the implementation of the problem-solving plan for the first problem. Then, figure 8 shows the problem-solving method for the second problem. Figure 9 shows the performance of the problem-solving strategy for the third problem. However, in implementing these steps, there were misconceptions made by students.
Fig. 7. The implementation of the problem-solving plan for the first problem.

Fig. 8. The problem-solving plan for the second problem

Fig. 9. The implementation of the problem-solving plan for the third problem
3.4 Re-check the problem-solving results

Students re-check the final answers that have been found. Based on the interview results, information was obtained that there were students who checked the results, and some were not because the processing time had run out. In general, from the three questions that have been answered by students. Based on the results of the study, it can be concluded that the subject understands the problem by identifying and writing down essential information by the questions being worked on. Besides, the issue compiles a problem-solving plan by writing down any steps that you want to take or making illustrations to solve the problem and determine the solution to the problem using the steps according to the plan. After that, check the results of the answers that have been done. The results of this study are by the results of research on the problem-solving abilities of prospective teacher students in linear program subjects [10], namely the issue can understand the problem by identifying the information that appears on the situation and determined using the simple method as a way of solving it by changing the story problem into a mathematical model. After that, finish with the simple process until you get the optimum solution and check the answer results that have been done again. However, in the third question related to trigonometric proof, students experienced a misconception. Following the research, one of the students’ difficulties in answering trigonometric problem-solving problems is misconceptions [6]. The interview results also showed that students were still confused about what to do to prove their trigonometric identity correctly.

4 Conclusion

The result of this research is that the subject can understand the problem by identifying the information that appears on the issue and determining the method or formula used in solving the problem. After that, solve the trigonometric problems given and check the results of the answers that have been done. The trigonometric material provided in the problem-solving ability test is the size of the angle, trigonometry ratio, and trigonometric identity. Students still have difficulty completing proving trigonometric identities because students are still confused and also experienced misconceptions in trigonometric and algebraic properties to confirm this trigonometric identity. Suggestions for further research are that this research is continued with an experimental study on the trigonometric module’s effectiveness to improve problem-solving abilities.

Acknowledgment. This research and development can be carried out well thanks to the resources of the Directorate General of Research and Development (Ditjen Risbang) Dikti. Not to forget our gratitude to the Institute for Research and Community Service and the mathematics education study program, University of Muhammadiyah Banjarmasin.

References


Bioavailability of Chromium in Spiked Soil by Sequential Extraction and Its Absorption in *Amaranthus hybridus*

Siti Karimah¹, Asep Saefumillah², Askal Maimulyanti³
{siti.karimah@sci.ui.ac.id¹, asep.saefumillah@sci.ui.ac.id², askal_m@yahoo.com³}

University of Indonesia¹,², AKA Bogor Polytechnic³

**Abstract.** Accumulation of heavy metals in agricultural soils continues to be a worrying problem, such as chromium. Chromium may become contaminants in the soil and were suspected mobilized to food crops such as green spinach (*Amaranthus hybridus*). Bioavailability of the heavy metal speciation in spiked soil can be carried out by sequential extraction method by Tessier with different reagents to obtain five fractions, exchangeable, bound to carbonate, bound to Fe/Mn, bound to organic matter, residual and analysed by AAS. *A. hybridus* were harvested after 8 weeks, destructed by wet destruction and analysed with ICP-MS. Results showed the highest distribution in organic, Fe-Mn, and residual phases with percentage concentration 61.33% ± 0.013, 26.88% ± 0.04, 7.55% ± 0.012. Addition of chromium made biomass of plant decreased and its accumulation detected in root > stem > leaf with transfer and bioconcentration factor less than 1 meaning *A. hybridus* has potential as chromium accumulator.

**Keywords:** Heavy metals, plant, sequential extraction, soil

1 Introduction

Accumulation of heavy metals in agricultural soils continues to be a worrying issue [1][2][3]. The ability of mobility and persistence of heavy metals such as chromium can bring toxic effects to the soil and then food crops [4]. Its toxicity effects can impact microorganisms to genotoxic and mutagenic in humans [5][6]. The accumulation of metals in the environment has the potential to cause chain toxicity effects due to the mobility from aquatic sources to plants that affect the food chain of living things[4]. Therefore, the method of speciation of heavy metals in soil can be carried out with the Tessier method.

Speciation of chromium has effect to its mobility and toxicity. Chromium speciation can be analysed with sequential extraction by Tessier. This method has also been widely used to analyze the speciation and bioavailability of metals in soil and sediment [8]. This method can provide information about the speciation of heavy metals in soil, which can be formed as an exchangeable fraction, carbonate bound, iron and manganese oxide bound, organic bound, and residual. For example, studied metal about bioavailability of heavy metals like As, B, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn in soil and food plants by comparing the extraction method used by BCR (The Community Bureau of Reference) [7] with the initial method proposed by Tessier, Campbell, & Bisson [8] showed similar results, even the Tessier method can be more detailed
because it is able to describe the associated fractions of manganese oxide and iron as separate amorphous and crystalline forms.

The leaves of Amaranthus are widely used, especially as food vegetables [9]. This plant has been shown to act as a metal accumulator in its leaves, such as the types A. hybridus and A. dubius tested with Cd, Ni, Pb, and Hg metal contamination [10] and A. blitoides also has the ability to phyto remediate Cu, Zn, Pb, Cd, and Cr [11]. The accumulation of metals in Amaranthus hybridus has been shown to have an effect on plant physiological such as yellowish coloration on the stems and leaves and stunted growth [12]. Information of chromium fractions from sequential extraction and its accumulation in every part of plant (root, stem, and leaf) by sequential extraction can provide information about chromium availability that may be mobile to plant. Chromium accumulation in plant was measured to determine the distribution and level of accumulation. Therefore the aim of this study was give information about chromium speciation in soil sample and its accumulated potential in Amaranthus hybridus.

2 Method

2.1 Materials

Nitric acid 65% (Merck), chloride acid 37% (Merck), potassium dichromate (Merck), calcium chloride, sodium acetate anhydrate (Merck), acetic acid, peroxide acid, perchloric acid (Merck), hydroxylamine hydrochloride (Merck), Amaranthus hybridus seed (East West), atomic absorption spectroscopy (AAS) Shimadzu AA-3600, and inductively coupled plasma-mass spectroscopy (ICP-MS) Nex Ion 300 Perkin Elmer.

2.2 Soil experiment

Soil sample was collected from Grogol, Depok, West Java, topsoil (0-30 cm) with yellowish brown color. Soil sample was dried, passed through 2-mm sieve and ready to be spiked with 10 mg/kg K₂Cr₂O₇. Soil was spiked with 10 mg/kg Cr from K₂Cr₂O₇. Spiked soil was incubated for 15 days before planted. Experiment has been done with triplicate.

2.3 Sequential extraction method with modification

Soil sample was treated by sequential extraction to achieve five fractions, respectively, exchangeable, bound to carbonate, bound to Fe-Mn oxide, bound to organic matter, and residuals. Sequential extraction prepared 300 gram dry soil and then spiked with Cr from K₂Cr₂O₇. The detail method is described in Table 1.

<table>
<thead>
<tr>
<th>Number of Fraction</th>
<th>Name of Fraction</th>
<th>Reagent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Exchangeable</td>
<td>0.5 M CaCl₂</td>
</tr>
<tr>
<td>2</td>
<td>Bound to carbonate</td>
<td>1 M NaOAc pH 5 with acetic acid</td>
</tr>
<tr>
<td>3</td>
<td>Bound to iron-manganese oxide</td>
<td>0.04 NH₄OH.HCl in 25% (v/v) HNO₃</td>
</tr>
<tr>
<td>4</td>
<td>Bound to organic matter</td>
<td>0.02 M HNO₃, 30% H₂O₂ pH 2 with HNO₃, 3.2 M NH₄OAc in 20% (v/v) HNO₃ dilute to 20 ml</td>
</tr>
<tr>
<td>5</td>
<td>Residual</td>
<td>Aqua regia</td>
</tr>
</tbody>
</table>
2.4 Preparation of plant experiment and wet destruction

Plant seeds collected from East West, green Amaranth (Amaranthus hybridus). Seed was sowed for 7 days and were transferred to spiked soil. Soil was moisturized every day to maintain 60% MWHC. Plant sample collected after 8 weeks. The plant rinsed with deionized water, dried in oven 80°C, and dry weight measured. Then dry plant were finely ground and ready to be destructed.

Plant samples divided into root, leaf, and stem were put into each beaker and added 2.5 mL HNO₃ 65% then left overnight. The next day it was heated at 100°C for 30 minutes, cooled and added 2.5 mL nitric acid and 0.5 mL HClO₄. Then heated to 130°C for 30 minutes, temperature was increased to 150°C (until the yellow fumes runs out). Then the temperature was gradually increased to 170°C and 200°C for 30 minutes until white fumes formed. Destruction was completed until white precipitate was formed about 1 mL. The liquid precipitate was then filtered and dissolved to 10 mL and ready analyzed with ICP-MS.

The percentage of metal concentration of each fraction was calculated based on the total concentration detected. Then, as one of the factors in the mobility index of heavy metals from the soil to plants, the TF (transfer factor) and BCF (bioconcentration factor) test were calculated. According to [14], transfer factor can be calculated as the ratio of Cr concentration in aerial parts to Cr concentration in root.

\[ TF = \frac{C_{Cr \text{ in aerial part}}}{C_{Cr \text{ in root}}} \]

And also BCF can be calculated as ratio of metal concentration in tissue plant (stem, leaf) to that spiked soil [12]

\[ BCF = \frac{C_{Cr \text{ in tissue plant}}}{C_{Cr \text{ in soil}}} \]

3 Results and Discussion

3.1 Physiochemical properties of soil samples

Soil samples were obtained from rice fields in Kampung Rawa Kalong, Grogol, Depok, West Java. The irrigation source is river water which is located around the field. Sampling position at 6°22'41" S 106°47'30" E (latitude position 6 degrees 22 minutes 41 seconds and longitude position 106 degrees 47 minutes 30 seconds).

The bioavailability of heavy metals in soil can be influenced by several factors, namely soil pH, soil texture, water resistance capacity (WHC), cation exchange capacity (CEC), and total organic carbon. The sample was in the acidic pH range with a pH of H₂O 4.4 ± 0.00 and a KCl pH of 3.73 ± 0.00. An acidic pH value indicates that the soil sample has a fairly good pH condition as a medium for metal mobility even though there is a risk of lack of nutrients for plant growth intake [3]. The measurement results of the soil texture showed that the dominant sample was composed of 62% clay followed by 2% sand and 36% dust. The content of dust and sand is composed of primary minerals in the form of quartz (SiO₂) and feldspar (MA13Si3O8) with M in the form of a combination of Na+, K+, Ca2+.

The dominance of clay in the soil texture also affects the relatively common cation exchange capacity (CEC) of 20.98 cmolc / kg. Soil texture of this sample dominated by clay, it can be a binding site where the metal cation exchange enters as a result of the formal charge -1 bond between AlO₃ and SiO₄. This can inhibit the movement of metals because they are bound to the surface of soil particles. Based on the results of soil characterization, the acidity of the
soil pH which is in the acidic range and the cation exchange capacity impact the mobility of cation.

3.2 Sequential Extraction of Soil

The concept of sequential extraction based on extraction of metals which are more easily mobilized first and then continues to metals with lower mobility. The sequential extraction method based on the Tessier method can provide information on the metal bound phases, fractions 1 to 5, respectively, exchangeable fraction, bound to carbonate, Fe-Mn bound, organic bound, and residual. Extraction of metal starts with ionic reagents which able to carry metals that are on the ground surface of soils. Then the carbonate fraction is obtained with a buffer solution. The fraction bound to Fe-Mn is made in anoxic state, the organic fraction, the material needs to be oxidized, and last the residual fraction uses strong acids to break silica bonds [1] [2]. Based on Figures 1 and 2, distribution of Cr in the control soil was showed in the Fe-Mn fraction, organic, and also residuals of 0.003 ± 0.0001, 0.0027 ± 0.0002, 0.00068 ± 0.00 mg/kg or 0.08% ± 0.00, 73.5% ± 0.0002, and 7.55% ± 0.00. The exchangeable and bound to carbonate fractions were below AAS detection limit.

After the addition of chromium spikes to the soil, the percentage of metal in the spiked soil fraction were increase. Percentage of exchangeable, bound to carbonate, bound to Fe-Mn, bound to organic matter, and residual fractions respectively 1.41% ± 0.012, 2.81% ± 0.012, 26.88% ± 0.04, 61.33% ± 0.013, 7.55% ± 0.012. The most Cr concentration was detected in fractions 3, 4, 5 with a concentration of 0.00453 ± 0.0004, 0.0097 ± 0.00013, 0.0014 ± 0.00012 mg/kg. Sequential extraction of Cr-contaminated soil with Camellia sinensis showed same results that chromium has low mobility, but it was mostly bound in the form of organic compounds, Fe-Mn, and also residuals [3].

![Fig.1 Cr concentration in control and spike soil (mg/kg) with n = 3. Fraction 1, 2, 3 for control soil were below detection limit.](image-url)

Fig.1 Cr concentration in control and spike soil (mg/kg) with n = 3. Fraction 1, 2, 3 for control soil were below detection limit.
3.3 Plant experiment

Figure 3 showed accumulation Cr in every part of plant, root, stem, and leaf of A. hybridus. The highest concentration found in root, followed with stem, and leaf with 0.71, 0.51, and 0.14 mg/kg. Several studies have shown that Amaranthus hybridus is shown to be tolerant of heavy metal accumulation [6] even with low mobility due to its root uptake mechanism.

Contaminated soil also give effect that made yellowish leaves and stems tended to be thinner and slower leaf growth. The chromium-spiked plant biomass showed a decrease in biomass in every parts (Table 2). Table 2 showed that the accumulation of chromium in A. hybridus causes a decrease in the weight of the organ biomass in plants. This stunted growth
due to metal toxicity which can inhibit the intake of nutrients needed for plant development [14]. Many studies show that the root is the plant organ that accumulates the most heavy metals. Its location in direct contact with the soil makes it easier for the roots to absorb heavy metals than aerial parts such as stems and leaves [4].

Table 2. Biomass of dry weight of A. hybridus

<table>
<thead>
<tr>
<th>Biomassdry weight (g)</th>
<th>Root</th>
<th>Stem</th>
<th>Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.063</td>
<td>0.031</td>
<td>0.086</td>
</tr>
<tr>
<td>Spiked Soil</td>
<td>0.031</td>
<td>0.025</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Transfer factor values of root-stem and root-leaf also showed values less than 1 (Table 3). This value less than 1 that means A. hybridus has a potential as accumulator of chromium but not in hyperaccumulator type. Bioconcentration factor can show the effectiveness of metal accumulation in A. hybridus. Based on the results, the BCF value tends to be low from the range of 0.01 to 0.07. This shows that the mobility of Cr from the root to the stem is greater than that of the leaf. Based on these two results, A. hybridus could potentially be a Cr accumulator.

Table 3. Transfer and bioconcentration factor of A. hybridus

<table>
<thead>
<tr>
<th>TF</th>
<th>BCF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root-Stem</td>
<td>0.69</td>
</tr>
<tr>
<td>Root-Leaf</td>
<td>0.33</td>
</tr>
<tr>
<td>Root</td>
<td>0.07</td>
</tr>
<tr>
<td>Stem</td>
<td>0.05</td>
</tr>
<tr>
<td>Leaf</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Research on other plants such as Allium cepa has also shown an increase in Cr accumulation in plant parts such as leaves along with the addition of Cr spikes (0-50 µg/L) [15]. Cr accumulation also affects plant growth due to inhibition of its photosynthetic activity, for example in other Amaranthus species, Amaranthus viridis and Amaranthus cruentus [16]. Cr (III) has low solubility at pH <5.5, however, at pH> 5.5 Cr (III) almost all of them precipitate and form stable bonds in the soil. Cr (III) and Cr (VI) are very unstable in soil and remains mobilized at acidic and alkaline pH. Cr (VI) is usually in the form of oxyanions (HCrO₄⁻, Cr₂O₇²⁻, CrO₄²⁻). In plants, the mechanism of Cr (III) and Cr (VI) are not known for sure. This depends on the type of plant and the Cr speciation. Cr (III) species can enter the plant through passive transport without requiring the involvement of energy. Cr (VI) can be absorbed by plants through active transport (generally via the phosphate or sulfate pathways) because its structure resembles Cr (VI) with phosphate or sulfate [17].

4 Conclusion

This experiment showed that spiked soil distribute chromium mostly in the organic bound, Fe-Mn bound, and residual. Amaranthus hybridus can absorb and accumulate Cr in the roots>stems>leaves. The value of transfer factor Cr in A. hybridus is in the range 0.33-0.69. This plant has potential to be chromium accumulator.
Acknowledgement. This study was funded by Kementrian Riset dan Teknologi-Simlitabmas 2.0 period 2020 with contract number NKB-4853084/UN2.RST/HKP.05.00/2020.

References


The *Muntingia calabura* Leaves Extract Effect on Respiration and Heart Performance of Zebrafish (*Danio rerio*): The Search for Covid-19 Control Agent

Siti Zar’ah¹,², and Bambang Retnoaji¹

¹ Departement of Biology, Universitas Gadjah Mada, Jl. Teknika Selatan Sekip Utara, 55281, Indonesia,
² Master Program in Biology, Graduate School, Departement of Biology, Universitas Gadjah Mada, Jl. Teknika Selatan Sekip Utara, 55281, Indonesia

Abstract. Currently, the world community faces the Covid-19 pandemic phenomenon since December 2019 and has caused many victims. Various methods have been used to prevent and treat patients affected by this viral infection, especially in medical care. In addition to medical efforts, exploring natural material potential as a controlling agent for Covid-19 has been widely carried out. The purpose of this study was to examine the potential of *Muntingia calabura* as a controlling agent for Covid-19, by studying the secondary metabolite effects of *Muntingia calabura* leaves on zebrafish (*Danio rerio*). Research focuses on the administration of *Muntingia calabura* leaves extract and its impact on the organ respiration, heart rate and swim mobility on zebrafish (*Danio rerio*) by microscopic and macroscopic observations. The *Muntingia calabura* leaves were extracted following the soxhlet method, which then used as supplement of zebrafish feed. The zebrafish were divided into 5 groups, of control and those treated with leave extract of 0.5 mg/L, 0.25 mg/L, 0.1 mg/L, and BSA alone, respectively. The results showed that *Muntingia calabura* leaves extract caused significant effects on zebrafish that decreased operculum opening, heart rate, and swim mobility. Data were analyzed with One-Way ANOVA, with the LSD Post Hoc Test and Duncan (DMRT), to determine the differences between each treatment group.

Keywords: *Mutingia calabura*, leaves, zebrafish, heart rate, respiration

1 Introduction

New cases of pneumonia were first reported in Wuhan, Hubei Province, in 2019. Five patients were diagnosed with Acute Respiratory Distress Syndrome (ARDS) from 18 to December 29 2019. The samples studied showed the etiology of the new coronavirus [1]. COVID-19 was first reported in Indonesia on March 2, 2020, in two cases [2]. Due to COVID-19 in Indonesia, the mortality rate is 8.9%; this figure is the highest in Southeast Asia [2]. Coronavirus is an RNA virus with a particle size of 120-160 nm. Coronavirus, which is the etiology of Covid-19, belongs to the genus betacoronavirus. The results of computer modeling show that SARS-CoV-2 has a 3-dimensional structure in the binding receptor spike domain protein similar to SARS-CoV.
In SARS-CoV, this protein has a strong affinity for angiotensin-converting-enzyme 2 (ACE2) [3]. In SARS-CoV-2, in vitro data supported the possibility that the virus could enter cells using the ACE2 receptor [4]. ACE2 receptor expression is found in several extrapulmonary tissues such as the heart, kidney, endothelium, and gastrointestinal tract [5]. ACE2 is highly expressed on the digestive tract epithelium cells’ lumen surface, which functions as a co-receptor in obtaining food and specifically for the absorption of amino acids from food. The ACE2 network is scattered in other organs and may explain the multi-organ damage observed in Covid-19 patients [6].

*Muntingia calabura* is a widely grown plant in Indonesia and people do not know much about *Muntingia calabura*’s benefits, and it causes many *Muntingia calabura* not to be used, especially in the health sector [7]. The *Muntingia calabura* is one of the plants used as traditional medicine or herbal medicine by the community. This plant's chemical constituents have been scientifically proven to have compounds of the flavonoid group and have good biological activity. Therefore, *Muntingia calabura* plants have great potential in the field of pharmacology as a medicinal plant.

Further research also needs to be conducted to understand the bioactivity of compounds on *Muntingia calabura* leaf that have not been widely disclosed [8]. Zakaria (2007) reported that *Muntingia calabura* leaves have antipyretic and anti-inflammatory activity. It showed that anti-inflammatory effect of the *Muntingia calabura* extract, which could be due to biologically active chemical constituents in the extract. These findings serve as scientific support for *Muntingia calabura* plants' therapeutic use in traditional medicine [9].

The zebrafish (Danio rerio) were used as model organism in research for more than 100 years [10]. Zebrafish is used as a research tool on infectious diseases and host-pathogen interactions [11]. Several models of bacterial, viral, and fungal infections have been investigated using zebrafish [12]. Moreover, gills in fish are multifunctional organs that aid in critical physiological processes [13]. Therefore, study to reveal the potential of Muntingia calabura leaf for covid-19 control agent was urgently needed.

Bovine serum albumin (BSA) is a biologically stable globular protein used in various biochemical applications [14]. BSA is a plasma protein of cattle having 76% similarity with HAS (Human Serum Albumin) and composed of a single polypeptide chain consisting of more than 500 amino acid residues [15]. BSA effects on the sarcoplasmic reticulum channel important on lipid bilayer, which affects muscle contraction [16].

## 2 Method

### 2.1 Research location

The research was conducted at the Laboratory of Animal Structure and Development, Faculty of Biology, Universitas Gadjah Mada in October-November 2020.

### 2.2 Muntingia calabura extraction

The *Muntingia calabura* leaf extraction were conducted following standard soxhletation method. The fresh *Muntingia calabura* leaves number 3-5 from the tip were collected and
washed with clean running water, drained, and dried at 36°C in an open air. The dried leaves were then mashed with blender, to get leaf powder, which then be wrapped with filter paper and put in a round bottom flask on the sox. The process was carried out at 70 ° C until the drops on the cycle are colorless. The extract obtained was concentrated with rotary evaporator at 55°C until it got a thick extract from ethanol. The thick extract of *Muntingia calabura* leaves was put on oven at 50°C to remove moisture.

2.3 Leaf extract pellets

Takari brand fish feed of 40 grams were gindedr and divided into 4 different containers. 5 ml of *Muntingia calabura* leaf extract solution is mixed in 10 grams of feed with concentrations of 0.5 mg/L, 0.25 mg/L, and 0.1 mg/L, repelleted with pellete and dried.

2.4 Zebrafish maintenance

Wild type zebrafish (*Danio rerio*) were obtained from Leiden University and cultivated at the Faculty of Biology, UGM. The fish were maintained in a cycled aquarium at room temperature between 27-28.5°C and feed three times a day. Zebrafish broodstock are spawned to obtain eggs that will be reared until the age of 1 month for treatment. Adult zebrafish are placed in an aquarium of 8 cm x 8 cm and a height of 10 cm.

2.5 Preparations of BSA solution

Bovin Serum Albumin (BSA) was used as irritant or stressor to induce the stress on the fish, which then be treated with the extract. 0.1 g of BSA was dissolved in 1 L of water. BSA solution was put into the treatment aquarium as much as 250 mL for 4 aquariums, 1 aquarium filled with normal water. BSA solution was used to induce immune effect of the zebrafish in the aquarium and as a negative control.

2.6 Treatment of extract-feeding

Zebrafish WT AB/TL strain were used as experimental animals, which were grouped into five group, namely: 1) Control (zebrafish in water media with regular fish feed), 2) negative control (zebrafish in BSA solution with ordinary fish feed), 3) zebrafish in BSA solution + *Muntingia calabura* leaf extract 0.5 mg / L, 4) zebrafish in BSA solution + *Muntingia calabura* leaf extract 0.25 mg/L, and 5) zebrafish in a solution of BSA + *Muntingia calabura* leaf extract 0.1 mg/L. The zebrafish were feed with *Muntingia calabura* leaf extract or regular pellet 3 times a day for 14 days.

2.7 Data collections

All group treatments were observed with a Leica DM750 microscope to determine zebrafish frequency of operculum opening and heart rate. Operculum opening frequency was observed by counting zebrafish's operculum opening in 1 minute. Heart rate was observed by counting heartbeats in 1 minute period.

The zebrafish range is determined by dividing the area in the aquarium. An aquarium with a base of 8 cm x 8 cm and a height of 10 cm is divided into 4 places shown in figure 3.4. The zebrafish movement is calculated based on the number of zebrafish across the divided side in one minute.
2.8 Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics 25. One Way ANOVA test was used to determine differences between treatment groups of various Muntingia calabura extract concentrations. Data were presented as mean, standard deviation and were considered significant if $P < 0.05$.

3 Results and Discussion

3.1 Effect of Muntingia calabura extract on zebrafish operculum opening frequency

The result showed the variation of operculum opening on the fish of control and treated fish as presented on Figure 3.1.

Figure 3.1. Frequency of zebrafish operculum opening on the first, seventh and fourteenth day.
Data showed that the most frequent of operculum opening frequency was performed by the control group at the first day of treatment. On the other hand, the lest operculum opening frequent was showed by 0.5 mg/L leaf extract treatment group on the fourteenth day. The data also showed that on 0.1 mg/L group and 0.5 mg/L group were decreased operculum opening on seventh day and fourteenth day. Control group, BSA and 0.25 mg/L group were decreased from first until fourteenth day.

Figure 3.2. Operculum opening on the zebrafish, a) zebrafish on the first day, b) zebrafish on the seventh day, c) zebrafish on the fourteenth day.

### 3.2 Effect of Muntingia calabura extract as feed on zebrafish heart rate

Result showed the decrease in heart rate from the first day to the fourteenth day occurred in the extract treatment group 0.1 mg/L, 0.25 mg/L and 0.5 mg/L, while the BSA group was the group with the highest increase in heart rate (Figure 3.3.). The heart rate of adult zebrafish ranges from 120-130 beats per minute at 28°C [17].

Figure 3.3. Zebrafish heart rate on the first, seventh and fourteenth day.
The renin-angiotensin-aldosterone system is a major factor in maintaining arterial blood pressure. One of the target components is angiotensin-converting enzyme (ACE) which functions as a regulator of arterial blood pressure and electrolyte balance through the renin-angiotensin-aldosterone system. The highest concentration of ACE is in the capillaries of the respiratory organs. ACE is also found in the proximal tubule of the kidney, gastrointestinal tract, heart and brain [18]. *Muntingia calabura* leaves contain a group of compounds including flavonoids, phenolics, triterpenoids. Qualitatively, it is known that the most common compounds in *Muntingia calabura* leaves are flavonoids [19]. Several terpenoid and polyphenolic compounds including flavonoids, tannins, xanthones, procyanidins, caffeolyquinic acid derivatives are effective natural ACE inhibitors. Previous studies have shown that plant extracts rich in phytocemicals are effective as ACE inhibitors [18].

### 3.3. Effect of *Muntingia calabura* extract as feed on zebrafish swim mobility

![Figure 3.4. Swim mobility on the first, seventh and fourteenth day.](image-url)
Figure 3.5. Swim pattern of zebrafish that were observed from above of aquarium. a) Swim pattern on control group, b) Swim pattern on BSA and 0.1 0.1 mg/L group, c) Swim pattern on 0.25 mg/L group, d) Swim pattern on 0.5 mg/L group.

Figure 3.4 showed that the data on the effect of the Muntingia calabura extract on the zebrafish swim mobility. The graph depicts the value that tends to decrease with increasing treatment concentration. The decrease in the chart is thought to have been strongly influenced by the induction of BSA and Muntingia calabura extract in several concentrations. The BSA group and the 0.1 mg/L treatment group had the same trend, namely a decrease in the seventh day and an increase on the fourteenth day. Figure 3.5 showed that the swim pattern of zebrafish after treatment. Based on the swimming pattern of zebrafish, it showed that the cruising range was highest in the control group, namely zebrafish passing all sides of the aquarium in one minute. The zebrafish in the BSA group and the 0.1 mg/L treatment group had the same range of ranges across 3 sides in the aquarium. The zebrafish in the 0.5 mg/L treatment group had the lowest range of all treatment groups, which only stayed on one side of the aquarium.

BSA can induce several chemical secretions, one of which is interleukin-4 (IL-4) [20]. Interleukin-4 (IL-4) has a significant function in activating the heart rate. The increased heart rate value in BSA treatment influences the zebrafish operculum's opening frequency shown in Figure 3.3. Heart rate can be decreased due to BSA by giving Muntingia calabura leaf extract. The antioxidants in Muntingia calabura have a particular function in increasing immunity [21], so that the Muntingia calabura extract added to the BSA treatment has the effect of decreasing the value of the heart rate, operculum opening and swim mobility at average values.

In observing the behavior, the control group zebrafish was more responsive to feeding with Muntingia calabura leaf extract as the treatment in this study. These data indicated that the extract concentration of 0.5 mg/L caused a decrease in operculum opening, heart rate and swim mobility higher than the other treatment groups. Based on the LC50 test, the concentration of 0.5 mg/L of Muntingia calabura leaf extract is the limit for the concentration of surviving zebrafish, it means that the 0.5 mg/L or higher concentration of Muntingia calabura leaf extract has a toxic potential to zebrafish, because increasing the extract
concentration can decreased the operculum opening, heart rate and swim mobility. The extract at a dose of 0.5 mg/L was not effective because the results obtained were not the same as the control group.

The data of the research findings are linear with the one-way ANOVA statistical test conducted. The statistical test results showed that *Muntingia calabura* leaf extract significantly decreased operculum opening, heart rate and swim mobility of zebrafish.

4 Conclusion

This study concludes that *Muntingia calabura* leaves have potential as a controlling agent for Covid-19, by studying the secondary metabolite effects of *Muntingia calabura* leaves on zebrafish (*Danio rerio*). *Muntungia calabura* leaf extract has potential to induce the physiologies respond of the zebrafish, evidenced by significant decreased operculum opening, heart rate, and swim mobility of zebrafish. The extract toxicity effect on fish in this study was indicated on the concentration of higher than 0.1 mg/L of the extract.

Acknowledgment. The authors acknowledge all people involved in this research, Universitas Gadjah Mada and financial support provided by KEMENRISTEKDIKTI through Penelitian Tesis Magister 2020. Letter Task No.6/AMD/E1/KP.PTNBH/2020 and 3009/UN1.DITLIT/DIT-LIT/PT/2020.

References


Modelling The Number of Unemployment in East Java: Negative Binomial Regression Approach

Zakiatul Wildani¹, Sri Pingit Wulandari²
{zakia@its.ac.id¹, sripingitwulandari@gmail.com²}

Department of Business Statistics, Institut Teknologi Sepuluh Nopember
Kampus ITS Sukolilo-Surabaya 60111, Indonesia¹,²

Abstract. Unemployment is one of the benchmarks for the success of development in a country and affects sustainable economic growth in an area, including in East Java. The government has made lots of effort to overcome high unemployment, such as holding job fairs every month. However, in East Java, the unemployment rate in 2019 still exceeds the ideal unemployment rate, which is around 2-3 percent. Besides, there is no significant change in the unemployment rate in the last three years during 2017-2019. Therefore, this study aims to model the number of unemployment in East Java by using Negative Binomial regression. In other words, this study investigates how certain factors affect the number of unemployment in East Java. The Negative Binomial regression model is employed in this study as an alternative from the Poisson regression model because the number of unemployment is a count data and, in many cases, is overdispersion. That is, the comparison between the expected value is not the same as the variance. This research will contribute to the East Java Provincial Government or related labor agencies to overcome high unemployment. The finding shows that factors such as regional minimum wage and the number of enterprises significantly affect East Java's unemployment in 2019. Besides, the Negative Binomial regression model with only significant explanatory variables is the best model for modeling the number of unemployment with the lowest AIC value.

Keywords: unemployment, negative binomial regression

1 Introduction

Unemployment nowadays is still considered a significant issue in development and social humanities and economic growth encountered by many countries, including Indonesia. Currently, Indonesia is in the top four of the world's most populous countries, with nearly 280 million population equivalent to 3.51% of the total world population. The high population gives Indonesia on what-so-called bonus demography starting in 2020, which means that the proportion of a working-age population (age between 16-65) will rise and be expected at the peak in 2030 [1]. This bonus demography gives a benefit to the country in terms of boosting economic growth. However, at the same time, it poses some threats. Significantly, it will increase unemployment if the government fails to generate sufficient jobs.

By definition, unemployment is a situation when someone does not have a job and is currently searching for a job; planning for a business; are not looking for a job because they think it is difficult to get a job; and someone who already has a job but has not started the job yet [2]. Research from [3] stated that unemployment has a severe effect on economic progress
and the country’s improvement including the loss of human capital, the strain on families and societies, the primary cause of poverty, the fostering of social and criminal strife, and the hampering of regional growth. Therefore, the government should pay attention to the policies and focus on reviving the labor market and creating jobs as much as possible.

Based on previous research, unemployment is mainly caused by three factors, namely, population, economy, and education. From the population aspects, rapid population growth will impact unemployment if it is not supported by sufficient jobs available in the labor market. In terms of education, the standard of education for the working-age population is still low. Lastly, the economic factor that has not been focused on investment is being unable to absorb adequate labor. There is a standard measure of unemployment termed the unemployment rate, which is the number of unemployed individuals divided by the number of people in the labor force, consisting of both working and unemployed individuals. Indonesia’s unemployment rate is relatively high, around 7.1% compared to other countries such as Malaysia and Thailand, which is only 4.6% and 1.9%, respectively. Therefore, in this research, we will focus on investigating factors that significantly affect unemployment in one of the provinces in Indonesia, namely East Java using a regression model.

East Java is widely known as the second-most populous province in Indonesia. Around 14% of the countries’ population were residing in this province by the time of 2019. Its capital city Surabaya is recognized as the second-largest city in Indonesia after Jakarta and has become the center of industry and business. In 2019, the unemployment rate in East Java Province was 3.92%, very far from the ideal unemployment rate in developed countries, which is around 2-3 percent [4]. Figure 1 demonstrates there is no significant change in the unemployment rate in East Java for the last three years (2017-2019). In other words, the unemployment problem has not been fully resolved and still be a significant concern in this area. The provincial government, especially The Department of Labour and Transmigration of East Java and labor agencies in several regencies/cities under The Department of Labour and Transmigration of East Java, have held job fairs every month to reduce the high number of unemployment.

Many researchers have been modeling the unemployment rate to mitigate this issue. For instance, [5] utilized panel data regression to model the open unemployment rate because the unemployment rate might differ from time to time and region. The study showed that the population aged 15 years and over who worked by the highest education is senior high school or vocational, senior high school’s gross participation rate, dependency ratio and Gross Regional Domestic Product (GDP) have a major effect on the unemployment rate in Central Java. Besides, [6] also used the same model to model unemployment in East Java. Another research
was done by [7] employing another model to modeling the unemployment rate in Central Java that is Geographically Weighted regression. Besides, the Geographically Weighted Regression method (NGWR-TS) also can be employed in this case because the unemployment rate has no particular pattern in the regression curve [8]. This research found that factors such as percentage of the low population, percentage of low-educated or elementary school dropouts workforce, economic growth rate, investment ratio, regional minimum wage, the ratio of the amount of large-medium enterprises, percentage of people working in the agricultural sector, and area of agricultural land significantly affect the unemployment rate.

Another model proposed by [9], termed spline regression is conducted in modelling the unemployment rate in Sulawesi. The spline regression is utilised because its ability to the extreme up and down patterns with the dots knots. The research used two predictor variables, labor force participation rate and gross participation rate. Moreover, [10] discussed an extension of the spline regression namely Nonparametric Spline Truncated model to modeling the unemployment rate. The findings presented that labor force participation rate, dependency ratio, average years of schooling and economic growth rate have a significant effect on the unemployment rate in West Java.

Furthermore, [11] mentioned that the industrial sector's growth in labor absorption in Sidoarjo Regency has a positive effect on the employment rate. This study also showed that when the number of industrial sectors is increasing, the labor absorption in the industrial sectors will increase. This result is supported by [12], which said that the Small-Medium Enterprises (SMEs) have an importing rule in creating employment in Indonesia and significantly contribute to the GDP. Besides, SMEs played a significant role in absorbing many workers in Japan, China, India, The United States, Germany, and other countries [3].

All of the presented literature above uses various regression models to model the unemployment rate. However, to the best of our knowledge, not much literature discussed modeling the number of unemployment itself. The number of unemployment is a count data, therefore, we need to use discrete distribution such as Poisson distribution. Thus, this paper presents an approach to modeling the number of unemployment in East Java using Poisson regression. However, in Poisson regression analysis, there is a strict rule where the mean and variance must be similar and it is often rarely fulfilled because of the model's overdispersion. If overdispersion occurs, Poisson regression is not suitable for modeling data, and the estimator of the proposed model will be biased. One of the methods that can be used to overcome overdispersion in Poisson regression is Negative Binomial regression. Therefore, this study compares the Poisson regression model and the Negative Binomial regression model on modeling the number of unemployment in East Java. Furthermore, the comparison is based on the AIC value proposed by [13]. This paper contributes to the literature on alternative modeling of the number of unemployment, helping the government on management and readiness of demographic bonus as well as coping with a high number of unemployment.

2 Method

Before proceeding to the analysis, this section provides an explanation about the theoretical background of the regression model starting with poisson regression and subsequently the negative binomial regression model. The theory in this section is adopted from [14] and [15] if it is not mentioned otherwise.

2.1 Poisson Regression
Poisson regression is a nonlinear regression model that is often used to overcome count data where the response variable follows a Poisson distribution. The count data is a type of data where the values are non-negative, for instance, the number of accidents that happen in Surabaya in 2019, the number of unemployment and so on. The characteristics of the poisson experiments are

1. The number of outcomes are independent
2. Depends on a certain time interval.
3. An event that is included in the counting process.

If the discrete random variable \( y \) is a Poisson distribution with parameter \( \mu \) then the probability distribution function of the Poisson distribution can be shown in equation (1).

\[
f(y, \mu) = \frac{e^{-\mu} \mu^y}{y!}; y = 0, 1, 2, \ldots, n ;
\]

where \( \mu \) is the mean Poisson distribution where the mean and variance of \( y \) has a value of more than 0. The Poisson regression model can be written in equation (2).

\[
\mu = \exp (\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_p X_p) ,
\]

where \( \mu \) is the average number of events that occur within a certain time interval.

### 2.1.1 Parameter Estimation of Poisson Regression Model

One of the methods utilised to estimate Poisson regression parameters is the Maximum Likelihood Estimation (MLE) method. The MLE method is usually used by maximizing the likelihood function. In Poisson regression model, the estimated parameter is denoted by \( \hat{\beta}_k \).

### 2.1.2 Hypothesis Test

After the estimated parameter is obtained, we can proceed to the hypothesis test. There are two hypothesis tests termed simultaneous tests or widely known as overall significance parameter test and partial test. Overall significant parameter test is employed to determine the effect of parameters on the model with a certain level of significance. The parameter significance test of the Poisson regression model is performed by using the Maximum Likelihood Ratio Test (MLRT) method with hypothesis

- \( H_0 : \beta_1 = \beta_2 = \ldots = \beta_p = 0 \)
- \( H_1 : \) There is at least one \( \beta_k \neq 0 \), where \( k = 1, 2, \ldots, p \).

The test statistics used for the parameter significance test is shown in equation (3).

\[
D(\hat{\beta}) = -2 \ln \left( \frac{L(\hat{\alpha})}{L(\hat{\beta})} \right) ,
\]

where \( L(\hat{\alpha}) \) and \( L(\hat{\beta}) \) are the two likelihood functions associated with the regression model. \( L(\hat{\alpha}) \) is the maximum likelihood value for the model without involving predictor variables and \( L(\hat{\beta}) \) is the maximum likelihood value for the model involving predictor variables. The decision to reject \( H_0 \) if the value of \( D(\hat{\beta}) > \chi^2_{p} \), it means that at least one parameter has a significant effect on the model. \( D(\hat{\beta}) \) is the likelihood ratio statistic that follows the Chi-Squared distribution with \( p \) degrees of freedom [16]. Then performed partial parameter test to see the significance of the parameters on the model with the hypothesis.
\[ H_0 : \beta_k = 0 \]
\[ H_1 : \beta_k \neq 0, \text{ where } j = 1, 2, \ldots, p. \]
The test statistics used is following a Z distribution and can be shown in equation (4).

\[ Z = \frac{\hat{\beta}_k}{SE(\hat{\beta}_k)}, \]  

(4)

where \( SE(\hat{\beta}_k) \) is standard error value, that obtained from the \((k+1)th\) diagonal element of \((\hat{\beta})\) where \((\hat{\beta}) = -E \left( H^{-1}(\tilde{\beta}) \right) \). The hypothesis \( H_0 \) will be rejected if the value of \(|Z|\) is greater than the value of \( Z_{\alpha/2} \), where \( \alpha \) is the level of significance [16].

2.2 Overdispersion

As we have stated before, in the Poisson regression model there is a strict rule where the variance must be similar to the expected value. However, if the variance is greater than the expected value the Poisson regression model is said to be overdispersion. Suppose there is an overdispersion in count data and still use Poisson regression as the method for solving the problems, an invalid conclusion will be obtained because the standard error value will be underestimated. This is because the regression coefficient parameter that generated from the Poisson regression is inefficient even though the regression coefficient is still consistent. The value of Pearson Chi-Square dispersion \( D(\hat{\beta}) \) can be calculated with formula in equation (2). The value of \( \theta \) can be found by using the formula in equation (5), where \( df \) is the degrees of freedom that can be obtained from \((n - p - 1)\).

\[ \theta = \frac{D(\hat{\beta})}{df}. \]

(5)

If \( \theta > 1 \), it means that there is an overdispersion in Poisson regression. However, if \( \theta < 1 \), underdispersion is occurred in the model and if \( \theta = 1 \) means that there is no over/underdispersion or termed as equaldispersion.

2.3 Negative Binomial Regression

Negative Binomial regression model has a probability mass function that is shown in equation (6) as follows.

\[ P(y, \mu, \theta) = \frac{\Gamma(y + 1)}{\Gamma(\theta \mu) \Gamma(y + \theta \mu)} \left( \frac{1}{1 + \theta \mu} \right)^y \left( \frac{\theta \mu}{1 + \theta \mu} \right)^{\theta \mu}, \]

(6)

where \( y = 0, 1, 2, \ldots, n \) and \( \mu = \exp(\mathbf{X}^\top \mathbf{\beta}) \) [17]. Negative Binomial regression can be employed to modeling count data where overdispersion occur in the poisson regression because the Negative Binomial distribution is an extension of the gamma poisson distribution with dispersion parameter \( \theta \) [18]. In other words, this regression model loosens the extremely restrictive presumption that the variance is equal to mean in the poisson regression model. The condition of overdispersion is shown by the value of \( \theta > 1 \). The Negative Binomial regression model can be rewritten as follows.
\[ \mu = \exp \exp \left( \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_p X_p \right). \] (7)

### 2.3.1 Parameter Estimation of Negative Binomial Regression Model

The Maximum Likelihood Estimation (MLE) method is employed to estimate the parameter in Negative Binomial regression. The likelihood function of negative binomial regression is shown below.

\[ L(\beta, \theta) = \prod_{i=1}^{n} \frac{f(y+\frac{1}{\theta})}{f(y)} \left( \frac{\theta \mu_i}{\theta \mu_i + 1} \right)^y. \] (8)

The regression estimation utilizes Newton-Raphson iteration method for maximizing the likelihood function [19].

### 2.3.2 Hypothesis Test

The simultaneously parameter significance test of the Negative Binomial regression model using the deviance test with the hypothesis

- \( H_0 : \beta_1 = \beta_2 = \ldots = \beta_p = 0 \)
- \( H_1 : \) There is at least one \( \beta_k \neq 0 \), where \( k = 1, 2, \ldots, p \).

The test statistics used for the simultaneously parameter significance test is shown in equation (3) where \( H_0 \) will be rejected if the value of \( D(\hat{\beta}) > \chi^2_{p} \). Furthermore, the partial parameter significance test shows the significance of the parameter individually on the model with the hypothesis

- \( H_0 : \beta_k = 0 \)
- \( H_1 : \beta_k \neq 0 \), where \( j = 1, 2, \ldots, p \).

The test statistics used for the partially parameter significance test is defined by

\[ W_k = \frac{\hat{\beta}_k}{SE(\hat{\beta}_k)}. \] (9)

where \( H_0 \) will be rejected if the value of \( W_k \) or \(|t|\) is greater than the value of \( t_{\alpha/2} \). Rejecting \( H_0 \) means that the \( k \)th parameter significantly affects the response variable [19].

### 2.4 Akaike Information Criterion (AIC)

One of indicators for choosing the best model that is generally used in a regression model is the value of Akaike Information Criterion (AIC). This method is based on the MLE method. The formula for calculating the value of AIC has the form in equation (10).

\[ AIC = -2 \ln L(\beta) + 2k, \] (10)

where \( L(\beta) \) is the value of likelihood and \( k \) is the number of parameters. The best regression model is a regression model that has the lowest AIC value [20].
3 Result and Discussion

We consider data obtained from an annual publication published by the Central Bureau of Statistics East Java in 2020. The object of observation is 38 regencies/cities in East Java Province.

3.1 Research variables

The variables used in this study are taken based on the previous researches (see [5], [6], [7], [8], [11]). More information regarding the variable can be seen in the table below.

Table 1. List of variables.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Explanation</th>
<th>Measurement Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>Number of unemployment</td>
<td>Discrete</td>
</tr>
<tr>
<td>X_1</td>
<td>Labor’s participation rate (%)</td>
<td>Ratio</td>
</tr>
<tr>
<td>X_2</td>
<td>Regional minimum wage (IDR)</td>
<td>Ratio</td>
</tr>
<tr>
<td>X_3</td>
<td>Percentage of the population age ten years or more with the highest completed high school level and bachelor’s education. (%)</td>
<td>Ratio</td>
</tr>
<tr>
<td>X_4</td>
<td>Number of enterprises (micro and small enterprises, medium and large enterprises)</td>
<td>Ratio</td>
</tr>
<tr>
<td>X_5</td>
<td>High school gross participation rate (%)</td>
<td>Ratio</td>
</tr>
<tr>
<td>X_6</td>
<td>Dependency ratio (%)</td>
<td>Ratio</td>
</tr>
</tbody>
</table>

Up until this point, we have discussed the theoretical background of Poisson and Negative Binomial regression and the considered predictor and response variables. To sum up, the following steps describe the modeling procedure for the number of unemployment in East Java.

1. Describe the characteristics of the number of unemployment and the factors that are expected to have a significant effect using descriptive statistics such as mean, median, etc.

2. Estimate the parameter of the Poisson regression model using Newton-Raphson algorithms.

3. Test the hypothesis of the Poisson regression model (simultaneous and partial parameter significance test).

4. Check whether there is overdispersion in the Poisson regression model. Dispersion estimation that is greater than one is evidence that overdispersion occurred.

5. Estimate the parameter of the Negative Binomial regression model using the Poisson gamma distribution algorithms.

6. Test the hypothesis of the Negative Binomial regression model.

7. Compared the proposed models based on their AIC values.

8. Make conclusions.

This chapter will explain the results of the analysis and discussion of modeling the number of unemployment in East Java in 2019 using Poisson regression and Negative Binomial regression.

3.2 Characteristics of the variables

The analysis is started by investigating the characteristics of the variables, for instance, mean, median, variance, etc. The result can be seen in Table 2.
Table 2. Characteristic of the variables.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Variance</th>
<th>Median</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>22204</td>
<td>335180615</td>
<td>17736</td>
<td>1715</td>
<td>91912</td>
</tr>
<tr>
<td>X&lt;sub&gt;1&lt;/sub&gt;</td>
<td>69.48</td>
<td>12.26</td>
<td>69.12</td>
<td>63.11</td>
<td>79.55</td>
</tr>
<tr>
<td>X&lt;sub&gt;2&lt;/sub&gt;</td>
<td>2254314.00</td>
<td>4.90 × 10&lt;sup&gt;11&lt;/sup&gt;</td>
<td>1854800.00</td>
<td>1763268.00</td>
<td>3871053.00</td>
</tr>
<tr>
<td>X&lt;sub&gt;3&lt;/sub&gt;</td>
<td>29.01</td>
<td>118.55</td>
<td>24.95</td>
<td>14.77</td>
<td>56.87</td>
</tr>
<tr>
<td>X&lt;sub&gt;4&lt;/sub&gt;</td>
<td>20688</td>
<td>158404288</td>
<td>20447</td>
<td>2618</td>
<td>52616</td>
</tr>
<tr>
<td>X&lt;sub&gt;5&lt;/sub&gt;</td>
<td>85.53</td>
<td>254.90</td>
<td>87.33</td>
<td>55.91</td>
<td>130.59</td>
</tr>
<tr>
<td>X&lt;sub&gt;6&lt;/sub&gt;</td>
<td>44.08</td>
<td>12.66</td>
<td>43.82</td>
<td>35.91</td>
<td>52.21</td>
</tr>
</tbody>
</table>

Table 2 shows the variance of the response variable; where in this case, the number of unemployment is higher than the average. Therefore, this is a sign of overdispersion occurring in the data. Furthermore, the lowest number of unemployment (Y) is 1715 people were in Mojokerto. Meanwhile, Surabaya had the highest unemployment in 2019. The average labor participation rate (X<sub>1</sub>) was 69.48%, and the lowest score in Bangkalan, while the highest score in Pacitan. Moreover, the average regional minimum wage (X<sub>2</sub>) was IDR 2254314.00, with the lowest value in Pacitan (IDR 1763268.00) and the highest value in Surabaya (IDR 3871053.00). Besides, the average of the population aged ten years or more with the highest completed level of education is high school and college (X<sub>3</sub>) was 29.01%, with the lowest score in Sampang and the highest score in Madiun. The average number of industries (X<sub>4</sub>) was 20688 industries. The average high school gross participation rate (X<sub>5</sub>) was 85.53%, with the lowest score in Bangkalan and the highest score in Sidoarjo. Finally, the average dependency ratio (X<sub>6</sub>) was 44.08% per 100 population with the lowest value in Surabaya and the highest value in Bangkalan.

### 3.3 Multicollinearity check

Multicollinearity is a condition where the predictor variables have a linear correlation (significant relation). One of the methods used for detecting multicollinearity is the Variance Inflation Factor (VIF) value. If a predictor variable has a linear correlation with other predictor variables, the VIF value will be more than 10. The results of the multicollinearity check in this analysis are shown in Table 3.

Table 3. Multicollinearity check.

<table>
<thead>
<tr>
<th>Variable</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>X&lt;sub&gt;1&lt;/sub&gt;</td>
<td>1.47</td>
</tr>
<tr>
<td>X&lt;sub&gt;2&lt;/sub&gt;</td>
<td>1.70</td>
</tr>
<tr>
<td>X&lt;sub&gt;3&lt;/sub&gt;</td>
<td>3.25</td>
</tr>
<tr>
<td>X&lt;sub&gt;4&lt;/sub&gt;</td>
<td>1.76</td>
</tr>
<tr>
<td>X&lt;sub&gt;5&lt;/sub&gt;</td>
<td>2.31</td>
</tr>
<tr>
<td>X&lt;sub&gt;6&lt;/sub&gt;</td>
<td>1.69</td>
</tr>
</tbody>
</table>

Table 3 indicates that VIF values for all explanatory variables are less than 10 which means that no multicollinearity or linear relationship between the predictor variables.

### 3.4 Correlation between the response variable and explanatory variables

Before we proceed to the estimation, we need to check the correlation between the response variable with each explanatory variable. The scatterplot between the number of unemployment in East Java with each predictor variable is depicted in Figure 2.
Figure 2. Scatterplot response variable vs. predictor variables.

Figure 2 shows no sign of positive correlation or negative correlation between the response variable and predictor variables except the regional minimum wage ($X_2$). The graph demonstrates correlation tends to be positive, which means that if the regional minimum wage increases, the number of unemployment will also increase. The correlation coefficient value also supports this result between the number of unemployment and the predictor variables shown in Table 4.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Correlation Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X_1$</td>
<td>-0.13</td>
</tr>
<tr>
<td>$X_2$</td>
<td><strong>0.64</strong></td>
</tr>
<tr>
<td>$X_3$</td>
<td>-0.002</td>
</tr>
<tr>
<td>$X_4$</td>
<td>0.32</td>
</tr>
<tr>
<td>$X_5$</td>
<td>0.10</td>
</tr>
<tr>
<td>$X_6$</td>
<td>-0.27</td>
</tr>
</tbody>
</table>

Table 4 shows a positive correlation coefficient between the number of unemployment with the regional minimum wage, the number of industries, and the high school gross participation rate. On the other hand, the correlation coefficient between the number of unemployment with the labor participation rate, the percentage of population ten years and over with the highest level of education completed is a high school or university, and the dependency ratio is negative. This result is in line with the relationship pattern shown in Figure 2.

3.45 Poisson regression model

The results of Poisson regression analysis in modeling the number of unemployment in East Java can be explained as follows.

3.5.1 Estimation and significance parameters of the Poisson regression model.

The result of the Poisson regression model's estimation and significance parameters for each predictor variables and intercept can be shown in Table 5.
Based on Table 5, the Poisson regression model can be formed as follows.

\[
\hat{\mu} = \exp(1.23 \times 10^1 - 3.86 \times 10^{-2}X_1 + 5.47 \times 10^{-7}X_2 - 1.56 \times 10^{-2}X_3 + 2.25 \times 10^{-5}X_4 + 1.63 \times 10^{-3}X_5 - 2.59 \times 10^{-2}X_6).
\]

Then, we proceed to the hypothesis test, such as the simultaneous parameter significance test, which is widely known as the overall significance test. This test is conducted to know whether all the predictor variables simultaneously have a significant effect on the response variable (the number of unemployment). Using a significant level \(\alpha\) of 0.05, we will reject the null hypothesis that all predictor variables are not significantly affecting the response variable if deviance is greater than \(\chi^2_{0.05(6)}\). Based on result in Table 5, the deviance is 219589 greater than \(\chi^2_{0.05(6)}\) that is 12.59. Therefore, \(H_0\) will be rejected. In other words, there are at least one of the predictor variables that have a significant effect on the number of unemployment.

After we conduct the simultaneous parameter significance test, we proceed to the partial parameter significance test. Unlike the simultaneous parameter significant test, where we measure all predictor variables’ effect on the response variable, we measure the effect of each predictor variable on the response variable in this test. Using a significant level \(\alpha\) of 0.05, \(H_0\) will be rejected if the \(|Z|\) value is greater than \(Z_{0.025}\) or if the \(p\)-value is less than \(\alpha\). Based on the results shown in Table 5, the value of \(|Z|\) for all predictor variables is greater than the value of \(Z_{0.025}\) that is 1.96. Also, \(p\)-value for all predictor variables is less than \(\alpha\). Consequently, the null hypothesis will be rejected. It means that each predictor variable affects the number of unemployed in East Java considerably.

### Table 5. Estimation and significance parameters of a Poisson regression model.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>Z</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.23×10^1</td>
<td>3.96×10^2</td>
<td>310.56*</td>
<td>0.00*</td>
</tr>
<tr>
<td>X1</td>
<td>-3.86×10^-2</td>
<td>4.19×10^-4</td>
<td>-92.17*</td>
<td>0.00*</td>
</tr>
<tr>
<td>X2</td>
<td>5.47×10^-7</td>
<td>1.73×10^-9</td>
<td>315.97*</td>
<td>0.00*</td>
</tr>
<tr>
<td>X3</td>
<td>-1.56×10^-2</td>
<td>2.04×10^-4</td>
<td>-76.52*</td>
<td>0.00*</td>
</tr>
<tr>
<td>X4</td>
<td>2.25×10^-5</td>
<td>1.15×10^-7</td>
<td>195.60*</td>
<td>0.00*</td>
</tr>
<tr>
<td>X5</td>
<td>1.63×10^-3</td>
<td>9.01×10^-5</td>
<td>18.11*</td>
<td>0.00*</td>
</tr>
<tr>
<td>X6</td>
<td>-2.59×10^-2</td>
<td>4.33×10^-4</td>
<td>-59.88*</td>
<td>0.00*</td>
</tr>
</tbody>
</table>

\(\text{Deviance} = 219589\)

\(\text{AIC} = 220041\)

* indicate the rejection of the null hypothesis at the 5% significance level test

3.5.2 Overdispersion Check.

Overdispersion check is managed by dividing the deviance by its degrees of freedom. The deviance value of the poisson regression model is 219589, and the degrees of freedom is 31 obtained from \((n-p-1)\), therefore, the ratio is 7083.52 greater than 1. Strictly speaking, there is overdispersion in the data of the number of unemployment in East Java in 2019. The parameter of Poisson regression that had overdispersion will be biased. Therefore, to resolve the overdispersion, the Negative Binomial approach will be used. Firstly, we need to determine the initial value for minimizing the dispersion parameter. The initial value is attained through trial and error until the division of deviance to degrees of freedom is one so that there is no overdispersion. The result of the trial and error for the initial value can be shown in Table 6 below.
Table 6. Trial and error for the initial value.

<table>
<thead>
<tr>
<th>Initial $\theta$</th>
<th>Deviance</th>
<th>df</th>
<th>Deviance/df</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5</td>
<td>41.73</td>
<td>31</td>
<td>1.35</td>
</tr>
<tr>
<td>3</td>
<td>35.77</td>
<td>31</td>
<td>1.15</td>
</tr>
<tr>
<td>2.5</td>
<td>29.81</td>
<td>31</td>
<td>0.96</td>
</tr>
<tr>
<td>2.6</td>
<td>31.002</td>
<td>31</td>
<td>1.00006</td>
</tr>
<tr>
<td>2.59</td>
<td>30.88</td>
<td>31</td>
<td>0.996</td>
</tr>
<tr>
<td>2.595</td>
<td>30.94</td>
<td>31</td>
<td>0.998</td>
</tr>
<tr>
<td>2.596</td>
<td>30.95</td>
<td>31</td>
<td>0.9985</td>
</tr>
<tr>
<td>2.597</td>
<td>30.97</td>
<td>31</td>
<td>0.9989</td>
</tr>
<tr>
<td>2.598</td>
<td>30.98</td>
<td>31</td>
<td>0.9993</td>
</tr>
<tr>
<td>2.599</td>
<td>30.99</td>
<td>31</td>
<td>0.9997</td>
</tr>
<tr>
<td>2.5991</td>
<td>30.99</td>
<td>31</td>
<td>0.9997</td>
</tr>
<tr>
<td>2.5999</td>
<td>31.001</td>
<td>31</td>
<td>1.00003</td>
</tr>
<tr>
<td>2.5998</td>
<td>30.999</td>
<td>31</td>
<td>0.99997</td>
</tr>
<tr>
<td>2.59985</td>
<td>31</td>
<td>31</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 6 shows that after some trial and error, we can obtain value one if the initial value is 2.59985.

3.6 Negative Binomial Regression

The results of Negative Binomial regression analysis on the modeling of the number of unemployment in East Java by using the initial value 2.59985 can be explained as follows. In addition to the Negative Binomial regression model, the estimation and significance parameters are presented in Table 7.

Table 7. Estimation and significance parameters of Negative Binomial regression model.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>$1.23\times 10^1$</td>
<td>2.97</td>
<td>4.16*</td>
<td>0.00*</td>
</tr>
<tr>
<td>$X_1$</td>
<td>$-4.15\times 10^{-2}$</td>
<td>$3.26\times 10^{-2}$</td>
<td>-1.27</td>
<td>0.21</td>
</tr>
<tr>
<td>$X_2$</td>
<td>$7.10\times 10^{-7}$</td>
<td>$1.75\times 10^{-7}$</td>
<td>4.05*</td>
<td>0.00*</td>
</tr>
<tr>
<td>$X_3$</td>
<td>$-2.24\times 10^{-2}$</td>
<td>$1.56\times 10^{-2}$</td>
<td>-1.44</td>
<td>0.16</td>
</tr>
<tr>
<td>$X_4$</td>
<td>$2.99\times 10^{-5}$</td>
<td>$9.92\times 10^{-6}$</td>
<td>3.01*</td>
<td>0.01*</td>
</tr>
<tr>
<td>$X_5$</td>
<td>$-4.17\times 10^{-3}$</td>
<td>$8.96\times 10^{-3}$</td>
<td>-0.47</td>
<td>0.64</td>
</tr>
<tr>
<td>$X_6$</td>
<td>$-1.89\times 10^{-2}$</td>
<td>$3.44\times 10^{-2}$</td>
<td>-0.55</td>
<td>0.59</td>
</tr>
</tbody>
</table>

Deviance = 31.00
AIC = 815.50
* indicate the rejection of the null hypothesis at the 5% significance level test

Based on Table 7, we can write Negative Binomial regression model as follow.

$$
\hat{\mu} = \exp(1.23\times 10^1 - 4.15\times 10^{-2} X_1 + 7.10\times 10^{-7} X_2 - 2.24\times 10^{-2} X_3 + 2.99\times 10^{-5} X_4 - 4.17\times 10^{-3} X_5 - 1.89\times 10^{-2} X_6)
$$

$$
\ln(\hat{\mu}) = 1.23\times 10^1 - 4.15\times 10^{-2} X_1 + 7.10\times 10^{-7} X_2 - 2.24\times 10^{-2} X_3 + 2.99\times 10^{-5} X_4 - 4.17\times 10^{-3} X_5 - 1.89\times 10^{-2} X_6
$$

Same procedures as the Poisson regression model above also proceed in this Negative Binomial regression model. In the simultaneous significance test with a significant level $\alpha$ of
0.05, we reject the null hypothesis if the deviance is greater than $\chi^2_{0.05(6)}$. Based on Table 7, the Deviance value is 31.00, greater than 12.59. Therefore, the null hypothesis that there are no explanatory variables that significantly affect the response variable will be rejected. It means there are at least one predictor variable that affects the number of unemployment. Then, the analysis will be continued to the partial parameter significance test. Using the same significant level of $\alpha$ 0.05, $H_0$ will be rejected if the value of |t| is greater than $t_{0.025,32}$ or if the p-value is less than $\alpha$. Table 7 shows there are only two variables that significantly affect the number of unemployment, namely the regional minimum wage ($X_2$) and the number of enterprises ($X_4$).

3.7 Negative Binomial Regression using significant predictor variables

The Negative Binomial regression analysis in the previous subsection shows that the regional minimum wage ($X_2$) and the number of industries ($X_4$) significantly affect the response variable with AIC value 815.50 while the other predictors are not. Therefore we need to re-modeling the Negative Binomial regression model with only significant predictor variables. Before we do that, we need to determine the initial value $\theta$ for minimizing the dispersion parameter. The initial value $\theta$ is obtained through trial and error to get the result of the division of Deviance value to degrees of freedom is equal to 1, therefore, there is no overdispersion. The results of the trial and error for the initial value can be shown in the table below.

<table>
<thead>
<tr>
<th>Initial $\theta$</th>
<th>Deviance</th>
<th>df</th>
<th>Deviance/df</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5</td>
<td>34.82</td>
<td>35</td>
<td>0.99</td>
</tr>
<tr>
<td>2.6</td>
<td>36.21</td>
<td>35</td>
<td>1.03</td>
</tr>
<tr>
<td>2.55</td>
<td>35.51</td>
<td>35</td>
<td>1.01</td>
</tr>
<tr>
<td>2.525</td>
<td>35.16</td>
<td>35</td>
<td>1.005</td>
</tr>
<tr>
<td>2.51</td>
<td>34.95</td>
<td>35</td>
<td>0.999</td>
</tr>
<tr>
<td>2.515</td>
<td>35.02</td>
<td>35</td>
<td>1.0007</td>
</tr>
<tr>
<td>2.5125</td>
<td>34.99</td>
<td>35</td>
<td>0.9997</td>
</tr>
<tr>
<td>2.5126</td>
<td>34.00</td>
<td>35</td>
<td>0.9997</td>
</tr>
<tr>
<td>2.5127</td>
<td>34.992</td>
<td>35</td>
<td>0.9998</td>
</tr>
<tr>
<td>2.5129</td>
<td>34.995</td>
<td>35</td>
<td>0.9999</td>
</tr>
<tr>
<td>2.5132</td>
<td>34.999</td>
<td>35</td>
<td>0.99997</td>
</tr>
<tr>
<td>2.51325</td>
<td>34.999</td>
<td>35</td>
<td>0.9997</td>
</tr>
<tr>
<td>2.51327</td>
<td>35</td>
<td>35</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 8 shows that by using the initial value 2.51327, we obtain a division between deviance value and degrees of freedom is 1. Then, modeling Negative Binomial regression using significant predictor variables will be done using the initial value 2.51327. Estimation and significance parameters of Negative Binomial Regression model using significant predictor variables only.

The estimation and significance parameters of the Negative Binomial regression model using significant predictor variables with the initial value 2.51327 can be shown in Table 9.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>7.78</td>
<td>3.39×10^{-2}</td>
<td>22.95*</td>
<td>0.00*</td>
</tr>
<tr>
<td>$X_2$</td>
<td>6.09×10^{-7}</td>
<td>1.28×10^{-7}</td>
<td>4.76*</td>
<td>0.00*</td>
</tr>
</tbody>
</table>
Based on Table 9, the Negative Binomial regression model can be formed as follows.

\[ \hat{\mu} = \exp(7.78 + 6.09 \times 10^{-7} X_2 + 3.36 \times 10^{-5} X_4) \]

\[ \ln(\hat{\mu}) = 7.78 + 6.09 \times 10^{-7} X_2 + 3.36 \times 10^{-5} X_4 \]

The simultaneous and partial significance test conclude that the null hypothesis is rejected, which means that the predictor variables significantly affect the number of unemployment with AIC values is 812.87.

### 3.8 Choosing The Best Regression Model

Up until now, we have successfully built three models for modeling the number of unemployment in East Java. Therefore, we need to choose the best model based on the lowest AIC value criteria. The AIC values from each regression model can be shown in Table 10.

<table>
<thead>
<tr>
<th>Regression Model</th>
<th>AIC Value</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poisson</td>
<td>219589</td>
<td>Overdispersion</td>
</tr>
<tr>
<td>Negative Binomial with all predictor variables</td>
<td>815.50</td>
<td>Equaldispersion</td>
</tr>
<tr>
<td>Negative Binomial with significant predictor variables</td>
<td>812.87</td>
<td>Equaldispersion</td>
</tr>
</tbody>
</table>

Table 10 shows that the Negative Binomial regression model with all significant predictor variables has the lowest AIC value, around 812.87, much lower than the other two models. Therefore, we choose this model over two other models. This model suggests that, ceteris paribus: as the regional minimum wage goes up by a rupiah, the number of unemployment in East Java increases around \( \exp(6.09 \times 10^{-7}) = 1.000000609 \). Moreover, as the number of enterprises in East Java goes up, the number of unemployment will rise around \( e(3.36 \times 10^{-5}) = 1.000033601 \). This result is different from the previous research where the growth in the industrial sector on labor absorption in Sidoarjo Regency has a positive effect on the employment rate (see [3], [11], and [12]).

### 4 Conclusion

Based on the analysis, we found that variable regional minimum wage (\( X_2 \)) and the number of enterprises (\( X_4 \)), either micro and small enterprises and large and medium enterprises, positively affect the number of unemployment in East Java in 2019. In other words, by ceteris paribus, increasing the regional minimum wage will increase the number of unemployment. This can be caused by various things, especially worker efficiency policies in the industries. Moreover, increasing the number of industries will also increase the number of unemployment in East Java. This finding is different from previous research that can be caused by the fact that a lot of human resources do not meet the qualifications set by the industry even though the number of industries is rising. Besides, the Negative Binomial regression model is the best
model for modeling the number of unemployment in East Java in 2019 with the lowest AIC value. A few limitations as follows. We restrict our study to the six predictor variables. Future studies could extend the regression by including or omitting a variable that is considered in this study. Note that the different predictor variables will produce a different result, seeing as each variable may react differently. In addition, future research is highly encouraged to extend our approach by considering different regression models such as panel regression, dynamic models, etc.

Acknowledgments. The authors would like to thank the Department of Business Statistics, Vocational Faculty, Sepuluh Nopember Institute of Technology for the grants and support to this research.

References

Virtual Laboratory Based on Discovery Learning to Train an Analyzing-Interpreting Data: A Systematic Review

Trijayanti P1, Nurfina Aznam2, Krisma Haryuniati3
{trijayantip.2019@student.uny.ac.id1,nurfina_aznam@uny.ac.id2,krismaharyuniati.2019@student.uny.ac.id3}

Science Education Department, Universitas Negeri Yogyakarta, Jl. Colombo No.1, Yogyakarta 55281, Indonesia1, Organic Chemistry Department, Universitas Negeri Yogyakarta, Jl. Colombo No.1, Yogyakarta 55281, Indonesia2, Social Science Education Department, Universitas Negeri Yogyakarta, Jl. Colombo No.1, Yogyakarta 55281, Indonesia3.

Abstract. Virtual laboratories based on discovery learning are an alternative source to support the distance learning process during the current pandemic. The study aims to provide an overview of how virtual laboratories based on discovery learning can be applied to the ability to analyze and interpret student data. The method used is a systematic review. The articles used are from Google Scholar and ERIC, then the search findings are directed to national and international journals published in 2010-2020. The number of articles used was 26 articles based on relevant research sources. The results of the analysis show that a virtual laboratory based on discovery learning can improve students' data analyzing-interpreting abilities through practicum simulations with scientific methods. Experimental simulations are carried out independently so that learning is more than meaningful. Students display data as proof to support their conclusion.

Keywords: Virtual laboratory, discovery learning, analyzing-interpreting data abilities.

1 Introduction

Advances in information communication and technology, both in commerce, socializing, playing, and learning, have changed the lifestyles of people. These technological advances have penetrated various aspects of life in the 21st century, with no exception in the field of education [1]. Currently, the development of science and technology is directed at reaching the objectives of national education. Article 1 of Law No 20 of 2003 on the National Education System aims to set out the objectives of national education, namely to develop the potential of students to have intelligence, personality, and noble character [2]. National education components provide the environment, infrastructure, resources and society [3].

The main factors for attaining education come from the curriculum, educators, and the learning process. Every learning requires a strategy, model, and learning media to give students a positive impression of learning activities. So the students' achievements progress and achieve the demanded national education goals. Approximately advancing the state of science learning, almost all materials require experimental activities to support learning objectives. This is strengthened by findings in several schools that: (1) the condition of school
laboratory facilities is uneven, generally low in terms of quality and quantity, (2) based on the aspect of the ability of educators, it was found that while the science tools were equipped with block grant funds it turns out that the implementation is rarely carried out only about 1-3 times a semester and takes place in an unstructured and productive process [4]. One of the determinants that influence the success of the laboratory activities is the availability of resources, including materials and equipment, space and appointments, laboratory assistants, and professionals. The availability of adequate resources will support the implementation of laboratory activities. On the other hand, the limitations of vehicles and stocks will lead to ineffective laboratory experiments, so that we need an innovation that can support learning activities [5].

Educational variation in the form of media utilization needs to be done so that students have complete knowledge of the concept of science. Science learning consists of many ideas and principles that are generally abstract. Science learning emphasizes providing direct experience to develop competencies to explore and appreciate the natural surroundings scientifically. Therefore, the approach applied in presenting science learning is to combine process experience and understanding of science products in direct experience. This approach is usually used in the form of experimental activities in the laboratory. However, in reality, learning activities are still overlooked by traditional learning models, straightforward learning with lecture methods and practices in laboratories, which have various obstacles, namely limitations on tools, time, and natural conditions.

There is trust in visualization to understand the concept of science. Students need various visualization elements, one of which is a virtual laboratory, to properly integrate new concepts. The use of virtual laboratories in science learning (1) allows for experimental activities that can be carried out for economic and spatial reasons, (2) allows visualization at microscopic, submicroscopic and symbolic levels, (3) provides submicroscopic dynamic presentations, (4) allows for a deeper understanding, (5) as a student motivation tool [6]. This is following previous research that states that laboratory activities play an important role in supporting scientific research and enabling students to understand practical skills through experiments so that students have a deeper understanding of the material being taught [7]. This occurs in research that claims that the virtual world can (a) increase the mastery of concepts through students; (b) develop the creative thinking skills of students and scientifically master problems; (c) improve skills in the field of ICT without neglecting lab knowledge [8].

The proper learning model is required to bridge and develop students' scientific thinking abilities. The suitable learning model is to apply the discovery learning model. Using the discovery learning model will develop students' abilities because the discovery learning model has stages that can train students' abilities. These stages include Stimulation, Problem Statement, Data Collection, Data Processing, Verification, and Generalization. Discovery learning emphasizes learning, which is a learner. It makes the students more active in learning and searching for material that will be more meaningful learning [9]. Discovery learning is a model where students build their knowledge through an experiment and discover a principle from the experiment results. Building knowledge means that students can identify problems, conduct experiments, collect data, and draw conclusions. From this process, students are expected to acquire new knowledge [10].

Efforts that need to be made to face global challenges in the 21st century are improving education according to national standards and how the education system complies with standards applied internationally. Therefore, the integration of Science and Engineering Practices (SEPs) based on the Next Generation Science Standards (NGSS) in science learning also needs to be done. NGSS is a framework in K-12 science education that contains a set of
knowledge (content) and science abilities expected to be comprehended by students in an integrated manner. NGSS was developed collaboratively by 26 US states hosted by the National Research Council (NRC) at the National Academy of Science by developing the K-12 framework. NGSS has an innovative structure that combines three main dimensions, namely: Disciplinary Core Ideas (DCI), (SEPs), and Crosscutting Concepts (CCs) into several small maps explicitly settled on a large theme that can be achieved by all students. NGSS has unique characteristics that emphasize three dimensions, which are interrelated and inseparable. These three dimensions are needed for quality science learning. This three-dimensional integration creates a deeper understanding into how scientific knowledge is obtained and understood and how science is connected through various disciplines through concepts that have universal meaning [11].

One of the practices that NGSS has is the Analyzing-Interpreting Data (AID) abilities. AID is a part of the SEPs dimension in NGSS. These dimensions inform design, enable predictions, assess performance, help define/clarify problems, determine cost estimates, and evaluate errors in investigations [12]. Meanwhile, scientific data obtain data that must be analyzed for meaning because patterns in data are not always clear. NGSS suggests that some very specific types of data analysis and interpretation are found in scientific practice because not all are relevant to student experiences. An order to get better results, consider the limitations of data analysis (for example, measurement error and attempt to improve data accuracy) with tools and technology. Therefore, to identify essential patterns in data, including tabulation, graphic interpretation, visualization, and statistical analysis, a variety of features is provided. Identifying only the source of the investigation error and calculating the certainty of the results [13]. The aim of this study is to provide an overview of how virtual laboratory based on discovery learning can improve the data analyzing-interpreting abilities of students.

2 Method

This research used a systematic review as a methodology. This method is related to the Covid-19 pandemic situation, which limits researchers in taking data. The number of articles used was 26 articles. Literature comes from several national and international journals through the Google Scholar and ERIC search engines related to research problems and objectives. The collection of literature uses several stages, including (1) creating a question frame for the topic to be reviewed, (2) identifying relevant research, (3) assessing the results of the research that has reviewed, (4) writing the results of the review (5) analyzing and interpreting the research results. The search for journal articles used to be published in the period 2010-2020 uses the title keywords including "virtual laboratory," "discovery learning," "analyzing and interpreting data," which identified and analyzed based on the relevance of journal content and the relevance of research topics [14].

3 Result and Discussion

This study begins by searching for journal articles through two online search engines source; there are Google Scholar and Education Resources Information Center (ERIC). Based on two online search engines source, it found that Google scholar has a much higher number
of ERIC. However, if we look at the quality of the articles ERIC are higher than Google Scholar. Based on the papers have gone through the screening stage, the next step is to answer the questions that have to ask.

3.1 Virtual Laboratory

A virtual laboratory is a system that can be used to support practicum that runs conventionally through simulation [15]. Thus, the virtual laboratory is a possible means of supporting students' interactive learning experience [16]. The features contained in the Virtual laboratory program consist of various formats, including text, hypertext, sound, images, animation, video, and graphics [17]. Virtual laboratory includes tutorials, simulations, evaluation, and virtual program laboratory equipped recording systems capable of storing participant data [18]. The content contained in the virtual laboratory consists of text, graphics, simulations, and animations [19]. The virtual laboratory can improve students' understanding of a complicated and abstract [20]. Besides, virtual laboratories can direct students to carry out several scientific activities, such as interpreting, predicting, applying concepts, planning research, communicating results, and asking questions [21].

Virtual laboratories improve students' practical experience in learning, are more economical, minimize the dangers of real laboratories, and are not tied to geographic location and time [22]. A more detailed explanation of the advantages of virtual laboratory[23] is as follows:

1) Diminished time constraints, if there is not sufficient time to teach all students in the laboratory until they understand
2) Defeat geographic boundaries, if there are students who live far from school
3) Economical, does not require laboratory buildings, vehicles, and materials as in traditional laboratories
4) Advance the experiment's quality because it allows it to be repeated and clarifies laboratory measurement uncertainties.
5) Enhancing the effectiveness of learning because students will spend more time doing lab run frequently
6) Gain security and safety because it does not interact with real and dangerous tools and materials.

The advantages of virtual laboratories are that they can improve students' mastery of concepts, improve creative thinking abilities and scientific problem solving, and develop ICT abilities without neglecting laboratories knowledge. Whereas the weakness of the virtual laboratory is that students must be connected to the internet or use a computer to simulate a practicum, lack of experience in a real laboratory, so that students are confused in assembling or operating tools in the virtual laboratory, and do not provide real practical experience [24].

Virtual laboratory product development results are: (1) the product is equipped with a pre-test to support the readiness of the students regarding the material will stimulate and post-test to measure the level of achievement of student understanding after using the product; (2) the product is equipped with particulate visualization that supports students' understanding of concepts that contain representations up to the sub-microscopic level; (3) the product can be used linearly or non-linearly by selecting the practicum menu to be simulated; (4) efficiency of tools, materials, and time even though practicum simulations are carried out as often as students want. The weaknesses of the virtual lab development results include: (1) the product can only run optimally on smartphones based on Android with version 5.0 (Lollipop) −7.0 (Nougat); (2) the sharpness of the color displayed on the product depends on the resolution/pixel density of the smartphone used [25].
Based on the description above, the Virtual laboratory is an interactive media that can visualize learning concepts in practicum activities through simulations. The features contained in the virtual laboratory is in the form of work steps tutorials, animated images, videos, hyperlinks, graphics, evaluation, and recording systems to save student data.

### 3.2 Discovery Learning Model

Discovery learning is a model that emphasizes the importance of understanding concepts, meanings, and relationships through an intuitive process to conclude. Students are actively involved, especially in mental processes, to find several concepts and principles through observation, classification, measurement, prediction, and determination [26]. Discovery learning is a model that directs students to discover concepts through various information or data obtained through observation or experiment [27].

The characteristics of the discovery learning model are (1) learner-centered; (2) investigate and resolve problems to create, connect, and generalize knowledge; (3) connecting new knowledge and existing knowledge. The steps for applying the discovery learning model are (1) fixing the learning objectives; (2) identify the characteristics of students; (3) determine the subject matter; (4) determine the topics that must be studied inductively; (5) developing materials by providing examples, illustrations, assignments, etcetera. For students to learn; (6) arranging lesson topics from simple to complex, from concrete to abstract, from enactive, iconic to symbolic stages; and (7) assessing students’ process and learning outcomes. There are procedures that must be used in applying the discovery learning model, namely (a) stimulation; (b) problem statement (problem identification); (c) data collection; (d) data processing; (e) verification (proof); and (f) generalization (draw conclusions) [1].

The advantage of discovery learning is that students are active in learning activities because they think and use the ability to find the final result. Students understand the learning material because they experience the process of finding it themselves. That which is obtained in this way is long remembered. The process of finding itself generates a sense of satisfaction. This inner satisfaction encourages wanting to get more findings so that the interest in learning increases. Students who acquire knowledge by discovery will be better able to transfer their knowledge to various contexts. In discovery learning, there are also obstacles faced by students. This obstacle is a drawback in discovery learning. The obstacles faced, for example, require a more extensive learning time than learning to accept.

### 3.3 Analyzing-Interpreting Data Abilities

There obtain a type of devices that can be used in the practice of analyzing and interpreting data. These devices include a table, graphs, mathematics, computer-based visualization tools, and statistical analysis techniques. Each device provides a different perspective on the relationship between the data that may be more or less efficient in dealing with the investigation or design questions specific [28].

Scientific research create data that should be analyzed for meaning. Scientists use various tools, including tabulation, graphical interpretation, visualization, and statistical analysis, to identify essential data features and patterns, declaring that data do not converse on an annual basis. The error reference is identified and certainty is calculated. Modern technology makes it possible and generate large data sets, providing many secondary sources for analysis [11].

How to analyze and interpret the data as follows:
1) Systematic data analysis to look for salient patterns or to test whether the data is consistent with the initial hypothesis.
2) Notice when the data is in conflict with expectations and consider what revisions are needed in the initial model.
3) To organize, summarize, and display data, apply spreadsheets, databases, tables, charts, statistics, mathematics, and information technology and computers, and explore the relationships between variables, especially those representing input and output.
4) Assess, using appropriate grade-level mathematical and statistical techniques, the conclusions drawn from any data set.
5) Identify patterns in the data that suggest a relationship exciting further. Distinguish between relationships between causal and correlational.
6) Collect data on physical models and assess for design under various conditions.

There are four aspects of analyzing-interpreting data: presenting data, organizing data, interpreting data, and summarizing data. Each indicator of data analysis-interpretation ability can be seen in the table below.

<table>
<thead>
<tr>
<th>No.</th>
<th>Aspect</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Display data</td>
<td>Display data in the form of tables, diagrams, or charts</td>
</tr>
<tr>
<td>2</td>
<td>Organizing data</td>
<td>Choose the appropriate data</td>
</tr>
<tr>
<td>3</td>
<td>Interpret data</td>
<td>Group similar data</td>
</tr>
<tr>
<td>4</td>
<td>summing up the data</td>
<td>Summing up the data</td>
</tr>
</tbody>
</table>

4 Conclusion

Virtual laboratory based on discovery learning can improve students' data analyzing-interpreting abilities through practicum simulations with scientific methods. Experimental simulations are carried out independently so that learning is more than meaningful. Students display data as proof to support their conclusion. The virtual laboratory has features that can visualize the concepts through a simulation like images, videos, graphics, hyperlinks, animation, evaluation, and recording systems for storing student data.

References


The Analysis of Senior High School Students’ Mathematical Communication Skill of Trigonometric Material

Upi Lidinillah¹, Endang Cahya M.A.²
{upilidinillah@upi.edu¹, endangcahya@gmail.com²}

Mathematics Education Study Program, School of Postgraduate, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia¹, Mathematics Education Department, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia²

Abstract. Math is required for students in order to have mathematical communication skills. This research was aimed to analyze the students’ mathematical communication skill on trigonometric material. This research utilized a qualitative approach in the form of a case study. There were six students from science major as the subject of the research. The data collection technique utilized tests and interviews. The data analysis techniques were conducted by data reduction, presentation of data, and drawing conclusion/verification. The research finding presented that the students’ mathematical communication skill is deficient. The causative factor because which some students can not hook real objects, pictures, and diagrams into mathematical ideas, inappropriate symbols used and explain the mathematical model perfectly. Students made types of mistakes such as adversity in communicating the mathematical model, misunderstanding about the questions and wrong variable concept used.

Key words: Mathematical Communication Skill, Trigonometry

1 Introduction

Communication skill is one of the main support for student success in learning the subjects at the school. Mathematical communication is a required skill to be given to students in math. Mathematical communication skill is a means on how students assert and interpret the ideas orally as well as in writing, either in the form of pictures, tables, diagrams, formulas or demonstrations [1]. Communicating orally and in writing in math class can help deepen their conceptual understanding. When students are encouraged to interact with others, they are able to build individual understanding and ordering of concepts [2]. The mathematical communication process can also give students the opportunity to share ideas [3].

The urgency to have mathematical communication skill is (1) power for students in formulating the mathematical concept; (2) the basis success for students toward completion of mathematical exploration and investigation; (3) a place for students to communicate with classmates in order acquiring information, sharing notion and discovery, giving an opinion, evaluating and sharpening the ideas to ensure others [4]. Low mathematical communication skill can encumber the students in the learning process nevertheless if students’ mathematical students' skill is good, it will bring a good impact both on students and teachers. From
mathematical communication skills, teachers can observe the students who have mastered the material and those who have not mastered the material [5].

Nevertheless, based on the result of the research, it was shown that the written students’ mathematical communication skills were in low categories, such as (1) unable to present the problems into mathematical model precisely; (2) unable to conduct the steps of the solving problems appropriately (3) incapable to obtain a final solution from students work results; (4) unable to interpret the mathematical solution acquired [6]. Especially in determining mathematical models such as in trigonometric material.

Trigonometry is a part of mathematics that is pertinent with angles of triangle and trigonometric function [7]. Trigonometry is necessary to be learnt for senior high school students because students must be able to relate triangular diagrams to numerical relationships and manipulate the symbols involved in these relationships [8]. In 2019, Trigonometry always appears on the National Examination (UN). Trigonometry must be mastered for class X SMA on math textbook of curriculum 2013, such as (1) trigonometric formula of right triangle; (2) angle of elevation and depression; (3) special angle on trigonometry; (4) sine and cosine rule; (5) trigonometric functions [9].

Trigonometry is an area of mathematics that students believe to be particularly difficult and abstract compared with the other subjects of mathematics [10]. Based on the data collected, explaining that the problem with algebraic, calculus, statistic, geometry and trigonometry always appears on the National Examination (UN). But in reality, comprehension of trigonometric material to students of senior high school of science program year 2018/2019 is low category, compared to other materials examined in the district, province, and national level. The following is the data percentage of material mastery in the questions of Senior High School National Examination of Science Program academic year 2018/2019 [11].

Table 1. The percentage of students’ correct answers of Mathematic National Examination Academic Year 2018/2019

<table>
<thead>
<tr>
<th>No.</th>
<th>Material Tested</th>
<th>National</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Algebraic</td>
<td>45.49</td>
</tr>
<tr>
<td>2.</td>
<td>Calculus</td>
<td>34.99</td>
</tr>
<tr>
<td>3.</td>
<td>Geometry and Trigonometry</td>
<td>34.59</td>
</tr>
<tr>
<td>4.</td>
<td>Statistic</td>
<td>35.02</td>
</tr>
</tbody>
</table>

From the table 1, the students’ percentage who answered geometry and trigonometry correctly are 34.59% from the total students 973,252 participating in the National Examination, geometry and trigonometry materials are in low level among other materials tested.

Table 2. Students’ Percentage who Answered Correctly the Trigonometry of Mathematics National Examination for Academic Year 2018/2019

<table>
<thead>
<tr>
<th>Serial Number</th>
<th>The indicator Tested</th>
<th>National</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>Determine the value of a trigonometric ratio in various quadrants</td>
<td>21.89</td>
</tr>
<tr>
<td>23</td>
<td>Determine the graphic picture from a trigonometric function</td>
<td>41.37</td>
</tr>
<tr>
<td>24</td>
<td>Accomplish the contextual problem related to sine rule and/or cosine rule</td>
<td>42.04</td>
</tr>
<tr>
<td>38</td>
<td>Accomplish the problem associated with cosine rule</td>
<td>28.09</td>
</tr>
</tbody>
</table>
Based on the table 2, it can be perceived that the percentage results of all indicators are below 55.00 which mean the student has low absorption of trigonometric material, and quite complicated for students.

Student activities in learning trigonometry do not constantly perform well, remaining several students who carry on the obstacle in answering the trigonometric questions. There are some factors that become the obstacles for students’ learning, (1) the obstacle of students’ mental unreadiness to learn (ontogeny); (2) the obstacle to inaccuracy teaching and materials (didactic); (3) the obstacle to insufficient prerequisite knowledge (epistemological) [12]. Lack of development of the necessary prerequisite schemes makes the conceptualization of students' mathematical concepts fixed or not developed [13].

The barriers to students’ learning in trigonometric materials have observed from research conducted by education practitioners. One of the research result presented that the mistakes done by all groups of students were an error in the form of deciding to utilize the strategy with elaborating each trigonometric comparison relationship which resulted in complicated calculations, the cause is the student’s inability to determine the relationship between trigonometric formulas and identities; errors in writing the math operation symbols and errors in conducting count operation of algebraic form with the result that students are less comprehensive when doing the calculation [14]. In line with other studies which say that the mistakes students often make in solving trigonometric problems include; (1) misunderstanding that occurs when students do not understand how to solve trigonometric problems given from the concept; (2) transformation errors that occur during the computation process, especially during multiplication; (3) in the process of skills that are more visible in the use of the right triangle method formula [15].

This article is concerned about the analysis of senior high school students’ mathematical communication skill on trigonometric material. students who have good mathematical communication skill will have the ability [16]: (1) connect the real things, pictures, and diagram into mathematical ideas; (2) explain the ideas, situations and mathematical relations orally or in writing with real objects, graphic images, algebra, (3) convey the daily events in the form of language or mathematical symbols. This research is intended to explore senior high school students’ mathematical communication skills toward trigonometric problems, the factor that causes the students to perform mistakes and the types of students’ mistakes in completing the mathematics question of trigonometric material.

2 Method

This research utilized the descriptive method in the form of a case study that explains about the development of something, revealing the cause and effect, and this research leads to present an overview of the existing situation. Whilst, the qualitative approach is used to describe the data collection in the form of words and sentences. This research was conducted in September. The subject of the research is 6 students at SMAN 3 Karawang. In this research, the researcher conducted a qualitative study in small scale that involved 6 students of senior high school students at science major. The data collection techniques were test and interview. The test is given to students only one time that is a written communication test in the form of essay questions consisting of three items. The interview was conducted to strengthen the result.
obtained from the written math communication skills test. After the data collection has completed, the next step is data analysis.

The data analysis techniques were conducted by data reduction, presentation of data, and drawing conclusion/verification [17]. Data reduction is an activity referring to the process organizing, selecting, simplifying and abstracting data obtained from the test results; presentation of data in this research is descriptive to provide the overview of presentable and organized information, therefore, there is a drawing conclusion from the data; drawing conclusion and verification are the activity to summerize and check the correctness of the data. To obtain the conclusion on this step, the factor that causes the students to perform mistakes in accomplishing the mathematics questions of trigonometric material and the types of students’ mistakes in completing the mathematics question of trigonometric material.

3 Result and Discussion

In this research, six students of senior high school at science major were asked to accomplish the trigonometric problems. The results:

Table 3. The result of mathematical communication skill

<table>
<thead>
<tr>
<th>Indicator of Mathematical Communication</th>
<th>Problems</th>
<th>S01</th>
<th>S02</th>
<th>S03</th>
<th>S04</th>
<th>S05</th>
<th>S06</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To link the real objects, pictures, and diagram into mathematical ideas.</td>
<td>A rumble strip built transversely in the road with angle 30° is like presented on the following picture.</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>If the rumble strip’s length is 8 meters, determine the wide of the road and explain it.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. To state the daily events into language and mathematical symbols.</td>
<td>Two cars depart with steady rate from house A at the same time at 07.00 o’clock. The first car moves with 30 Km/h to the east heading to house B and arrives at 12.00 while the second car goes with 16 km/h heading to house C So it is like angle 60o from the east and arrive at 11.00 o’clock. a. Make the mathematical model from the problems above</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
b. Determine the distance from house B to house C. Then write your reasons why do you apply sine and cosine rule to solve the problem.

3. To explain the idea, situations, and mathematical relation orally or in writing with the real objects, graphic pictures, and algebra. Draw a graphic function of $y = \sin (3x)$ where $0 \leq x \leq \pi$, then determine the maximum turning point, minimum turning point and explain it.

Based on table 1, the test results of communication skills given to senior high school students of science major obtained that student S01 has a low ability because of the incapability to fulfill indicator 1. Student S02, S03, S04, S04, and S06 have already fulfilled the indicator 1. For indicator 2, student S01 and S04 have a low ability to meet indicator 2 while students S01, S02, S05 and S06 have already met the indicator 2. For indicator 3, students S01, S04, S05 and S06 have not fulfilled the indicator 3. The cause of students having low mathematical communication skills due to lack of mastery of the language of mathematics, misinterpreting or applying formulas, not being careful, rushing in solving problems, and forgetting concepts [18]. Here are some students’ answers who have not attained their indicator of student’s mathematical communication skills.
Figure 1 showed the students’ answers of S01 and S06, it can be seen that student S01 is not able to link the real objects, pictures, and diagram into mathematical ideas on indicator 1. Student S01 solved a problem formerly by using cosine which student should overcome by drawing a right triangle first to perceive the trigonometric comparison used. The researcher concluded from the student’s writing that student does not still understand the material needed in the problems required in the questions, this caused the student was not able to fulfill indicator 1 which is contradictory with student’s answer S06, that a student can connect the real objects into math indicator. Besides the correct answer, the student also provided clear reasons for solving the problem. Mathematical communication skills become important when discussions between students are carried out, where students are expected to be able to state, explain, describe, listen, ask and cooperate so that they can lead students to a deep understanding of mathematics [19]. Meanwhile, in this case, S01 students have not been able to state and describe the problem. The researcher interviewed with S01, the answer is the student did not remember the formula used.

Figure 2a and 2b presented that S01 and S04 are not able to state the daily events into language and mathematical symbols in indicator 2. Student S04 has completed the solving problem on part 2a correctly however student has not figured out the speed of each car and student S01 used linear programming in solving the problem whereas it should not be applied. Students can answer immediately, by obtaining how the speed of each car heads to the city and afterwards, the model is drawn. The researcher interviewed with S04, the answer is the student imagined the concept to be used however student got confused to reveal it into a mathematical model. The interview result from student S01 merely understood the linear programming formula to solve the problem because a student did not know to answer using a trigonometric concept.
Figure 2b student S01 and S04 have accomplished the problem using sine rule without providing a correct reason why they apply its rule. Students have less attention to trigonometric concept used that caused errors in answers. This is in accordance with research which reveals that during teaching trigonometric material, the difficulties that are carried out by students mostly lie in the basic concepts of the material. Students know the concepts given by the teacher but have difficulty applying these concepts to problem solving [20].

Figure 3 indicated student S02 and S05. Based on their answers, students made a sketch and model that describe the problem from the question. Nevertheless, students merely have not been able to understand, explain and accomplish the problem very well. Student S02
answered incorrectly, a student just remembered and visualized the graph of \( y = \sin x \) when the form equation is changed then the student is not able to communicate and draw the graphic. If students are given a question that is different from the example problem they are confused because they don't know where to start from [21]. Different from student S05, a student could describe the graphic correctly however student was not able to reach indicator 3. This is in line with the results of the analysis obtained when students worked on story questions with trigonometric material, the error rate was mostly done by students at the encoding error stage where students did not write conclusions [22]. The interview result from student S02, a student was only able to describe the graphic function of \( y=\sin x \), a student will get confused to visualize the graphic if the question is changed, and the interview result from student S05 is adequate from answering the graphic function without being explained.

From the explanation of the research results above, in general the mistakes students do it because students do not understand what is being asked in the questions and have not been able to determine the formula or steps that should be used to solve the questions.

4 Conclusion

The research results presented that students’ mathematical communication skill are deficient. The factors that cause students to perform mistakes that inflict to their mathematical communication skill in low category which some students can not hook real objects, pictures, and diagrams into mathematical ideas, inappropriate symbols used and explain the mathematical model perfectly.

Students made types of mistakes such as adversity in communicating the mathematical model, misunderstanding about the questions and wrong variable concept used. Based on this research, the researcher suggests that students must receive problems to be resolved by communicating into a correct mathematical model in order their mathematical communication skill are enhanced optimally.

Acknowledgments. The writer says thanks to Dr H. Endang Cahya Mulyaning A., M.Si. for the comments and suggestions given and also Headmaster of SMA at science major for the participation.

References

The Implemented of Somatic, Auditory, Visualization, Intellectually, Repetition (SAVIR) Strategy toward Improved of Subject Learning Based on Multicultural Social Studies Learning

Ine Kusuma Aryani¹ and Subuh Anggoro²
{inepascapendas@gmail.com}

Magister Pendidikan Dasar, Universitas Muhammadiyah Purwokerto

Abstract. Associated with this Theme “Empowering Human Development Through Science and Education,” I make a title of my research about “The Implemented of SAVIR Strategy Toward Improved of Subject Learning based on Multicultural Social Studies Learning in Basic Education Postgraduate UMP.” Generally how common the implemented strategy SAVIR is the effective to improve understanding of concepts and think students creatively in Learning IPS-based Multicultural on PPS-UMP. This study aims to: 1) Describe strategic planning SAVIR on Multicultural-Based Social Studies learning for PPS UMP Students; 2) knowing the increase in the concept of Multicultural-Based Social Studies Learning in PPS students through the application of SAVIR strategy; 3) knowing the increase in the creative thinking skills of PPS students through the application of the problem-based SAVIR strategy. Subject Research is Basic Education Post Graduate (PPS) UMP, whose study about Social Studies/IPS Learning based Multicultural matter, that material can be defined as a form of awareness about the diversity of cultural, rights fundamental human as well as the reduction or elimination of various types of bias or prejudice to build a life community that fair and forward, education multicultural also be interpreted as a strategy to develop awareness on the pride of a person against his nation (The pride in one's home nation). The results of SAVIR strategy is learning that embraces the flow of science cognitive modern which is states that the most good learning is involve emotion, the whole body, all the senses, and all the depth and breadth of personal, respecting the style of other learning individuals by way of realizing that people learn in ways that differ. In this learning, the participants are required to search for and find the solution of a problem with doing. The fifth components of SAVIR integrated manner such the participant students and teachers can together turn the atmosphere of the class 85% understand. Learning containers of atmosphere that is varied so as not boring. The procedure of research is to adapt the model of development ADDIE which consists of five phases that include, results and conclude that: with interview the analysis 80%, design 80%, development 86%, implementation 90% and evaluation 90%.


1 Introduction

NKRI, the Unitary State of the Republic of Indonesia is one of the multicultural countries, has a diverse society, ranging from culture, language, religion, ethnicity and so on.
Recently, many problems have arisen in people's lives, such as religious problems triggered by religious differences to the same religion, problems with government policies, problems with political parties, and ethnic differences. The reduced distribution of welfare and the government's attention to its people has resulted in regions wishing to escape from this country, especially in border areas. Another problem in the field of education is that there are many problems with juvenile delinquency, murder, sexual harassment or rape where the perpetrators are still underage. The various problems above constitute a challenge to improve education in this country, because they have an influence on social, economic, religious, and cultural life, so that Social Science education (IPS) has a very important role in relation to multiculturalism in Indonesia.

Various problems such as in Aceh, Sambas, Ambon and other areas where problems between groups occur which have an impact on the sacrifice of life and property. The decreasing national spirit in the current era, especially the younger generation who is influenced by the development of information and technology continues to increase and is accompanied by the entry of foreign culture which also influences mental thinking, attitudes, behavior, and even clothing that does not reflect society or religion. in the State of Indonesia. Problems like this have a major impact on the advancement of the human resources of the Indonesian people and are interconnected between aspects of the social education sector that do not reflect both society and religion in the State of Indonesia and are interconnected between aspects of the field in relation to the implementation of development, as well as the open integration of one nation. 
width will be a threat (Sudrajat, 2014:17).

One example of a very small problem but a big problem and the principle that occurs, today many people are always more active in blaming others, especially on religious issues. Religion, which should serve as a guide in carrying out daily life side by side between humans, is actually one of the causes of problems. Religious differences always cause problems, but those with fellow religions participate in causing differences starting from different perspectives, lack of understanding, and eventually forming different groups. In addition, society is more competing with each other or competing which makes a person individualistic. So from the various problems that exist, education is expected as a strategic effort in addressing differences, especially religion, culture, ethnicity, race and can overcome problems that arise in people's lives. Education is at the same time one of the efforts to fulfill better quality human resources as capital in the development of the nation and the State, which currently emphasizes the aspect of character education. When talking about social science or social studies education, students' complaints are that it is difficult to understand because of the large amount of material and they have to read a lot, multicultural-based social studies learning which is unique to understand, with the help of the SAVIR (Somatic, Auditory, Visualization, Intellectually, Repetition) strategy it will be fun and not boring, bringing students to more comfortable studying Social Science.

The research objectives were, 1) To determine the description of Savir strategy planning in Multicultural-Based Social Studies learning for Post-Pendas PPS UMP Students; 2) To determine the increase in the concept of Multicultural Based Social Studies Learning in Post-Pendas students through the application of problem-based SAVIR strategies; 3) To determine the improvement of post-Pendas students' creative thinking skills through the application of problem-based SAVIR strategies.
2 Literature

2.1 Understanding the Descriptions and Concepts of Multicultural-Based Social Studies Learning Materials

Social studies education is learning that shapes students to become citizens in this life who feel peaceful, can have the competence to adapt, synergize and communicate well and can think positively towards others (Saidiharjo, 2004:43). At the elementary level, the integration of social studies which includes history, economics, geography and sociology is described in various topics of a subject. His study of the problem is the main thing in social studies learning. Social studies learning is a whole or a combination of several of these subjects, so this learning requires a variety of models. So Social Science is a subject that combines and integrates various basic concepts of the disciplines of history, geography, economics, sociology for education and can be useful for students in dealing with problems that arise in their lives. Some of the nature of the objectives in the Social Studies subject: Fostering students' knowledge of human experiences in social life in the past, present and future:

1. Students can improve their skills as information progresses.
2. Students can increase the value of attitude (value) in social life upholding democracy.
3. Students are given the opportunity to be able to play a role in the environment of social life (Chapin, in Ichas, et al, 2006)

Social studies learning develops students to make citizens have extensive knowledge, have values, can have a good attitude and can play a role in people's lives by upholding the democratic system that is studied from the aspects of social, economic, historical, geographic and humanities which are interconnected and complementary, this refers to the source of the National Council For The Social Studies (Chapin, in Ichas, et al, 2006). Social studies learning functions include:

1. Provide basic knowledge, both to continue to higher education and to apply it in everyday life.
2. Developing skills in developing social studies concepts
3. Instill a scientific attitude and train students in using scientific methods to solve the problems at hand.
4. Make students aware of the power of nature and all its beauty so that students are motivated to love and glorify their creator
5. Fostering students' creative and innovative power
6. Helping students understand new ideas or information in the field of Science and Technology
7. Cultivate themselves and develop students' interest in social studies (Ishack in Winataputra, 2007).

Mastery of various social science disciplines, social studies education can provide benefits in democratic social life, can instill values in Indonesian citizens with the provision of social sciences, and can instill a scientific attitude to be able to solve the surrounding problems faced. Likewise at school level education, IPS is expected to provide insights to encourage the desire to improve education to a higher level. The integration of social studies learning from various social science disciplines can be done based on certain topics that are still related to other disciplines of social studies disciplines. One example is the agricultural activities of the community, this agricultural activity can be developed in terms of the geographical aspect of a particular area, how the distribution of agriculture is, then the majority of the people who farm are how the situation is economically.
Multicultural education, education mostly directs to learn how to think rather than what is thought, teaches students how to understand knowledge, one of which can be done by increasing discussion activity in order to find different interpretations of understanding (Banks, 1993). In addition, multicultural education is an idea, a movement in the importance of manila diversity of cultures, lifestyles, different social conditions, individual differences, equal opportunities for individuals, groups or countries to obtain education. (Banks, 1993).

Multicultural education is said to be a strategy to take advantage of various cultures with different backgrounds from students, which is unique or characterizes students' cash to form multicultural attitudes. In addition, as a school institution, it can provide a shared understanding of different cultural concepts towards the establishment of a balanced and democratic life that can run properly (Liliweri, 2015). Multicultural education is a new symptom that hopes for equal rights, including the right to get the same education for every human being, this of course runs with a democratic process of human rights whose aim is not to differentiate between people even with different backgrounds. Multicultural education also appreciates many cultures as an objective state in society, its implementation explores various differences, creates a tolerant field of education (Choirul Machfud, 2005).

2.2 SAVIR Learning Strategy

Everyone has a different style of thinking and learning style. Some of us can learn best just watching other people do it. They prefer to write down what the facilitator has to say and not be distracted by midwifery. Such learning patterns are called visual learning styles. On the other hand, there are also many students who rely on their listening ability to remember and not a few students have the most effective way of learning by being directly involved in activities.

According to Silberman (2006: 17) Few students have one type of learning. Based on the research results of every 30 students, 22 of them can learn very effectively as long as the teacher presents learning activities in the form of a combination of visual-auditory-kinesthetic. However, the other 8 students only liked one form of learning so they had difficulty understanding the lesson if the delivery method was not suitable for their learning style. In order to meet this need, learning must be multisensory and full of variety.

DePorter (2005: 105) explains that learning based on activities is generally much more effective than being based on presence, material and media. The reason is the activity-based way of learning to get students fully involved. Good learning is to combine physical movements, with thinking (intellectual) activities and the use of all senses of hearing (audio) and sight (visual). The four elements must run synergistically, integrated and simultaneously.

Meier (2003: 81) argues that learning does not automatically increase by telling people to stand and move here and there, but combining physical movement with intellectual activity and using all the senses can have a major effect on learning. Meier added the Intelligence element from the learning proposed by DePorter and the learning was later called SAVI learning (Somatic, Auditory, Visualization, Intellectually) which was later called by adding the Repetition element. This repetition element needs to be added because in learning, repetitions are needed so that the information obtained is not easily lost and learning will be more meaningful. The explanation of the SAVIR learning strategy is as follows:

1. Somatic Learning: Somatic or somatic which means body movements (hand-on, physical activity) where learning by experiencing and doing with the sense of touch, kinesthetic, practical involves physically and uses and moves the body when learning. (Learn to move and do)
2. Auditory Learning: Auditory which means that learning must be by listening, listening, speaking, presenting, arguing, expressing opinions, and responding. Our hearing is stronger than we realize. Our ears respond to and store auditory information without us even knowing it. (Learn to speak and listen).

3. Visual Learning: Visualization which means that learning must use the eye senses through observing, drawing, demonstrating, reading, using media and teaching aids. Visual learners learn best when they can see real-world examples, diagrams, idea maps, icons, pictures, and descriptions of all kinds of things while they are learning. (Learn by observing and describing).

4. Intellectual Learning: Intellectually which means that learning must use the ability to think (mind-on). Learning must be with the concentration of the mind and practice using it through reasoning, investigating, identifying, discovering, creating, constructing, solving problems, and applying. Is a means by which humans think, reflect, solve problems and construct meaning, connect mental, physical, emotional, and intuitive experiences (learn to solve problems by reflecting).

5. Repetition Learning: Repetition is a repetition which means deepening, expanding, strengthening in the way students are trained through assignments or quizzes. (Learn to solve problems by repeating)

SAVIR learning adheres to the flow of modern cognitive science which states that the best learning involves emotions, the whole body, all senses, and all personal depth and breadth, respecting the learning styles of other individuals by realizing that people learn in different ways (Sugiarti, 2002: 56). In this lesson, students are required to seek and find solutions to problems by doing. The five components of SAVIR are integrated in such a way that students and teachers can together liven up the classroom atmosphere. Learning is packaged in a varied atmosphere so that it is not boring.

2.3 Problem Based Learning Model

Problem-based learning is one of the learning models associated with contextual learning (Sugiarti, 2012, 58). Learning means being faced with a problem, which then through problem solving, through this problem students learn more basic skills.

Before starting the teaching-learning process in the classroom, students are asked to observe a phenomenon first. Then students are asked to note the problems that arise. After that, the teacher's job is to stimulate students to think critically and creatively in solving existing problems. This is in line with Himelo-Silver's opinion (Eggen: 2012) which states that problem-based learning is a set of teaching models that use problems as a focus for developing problem-solving skills, materials and self-regulation. In this learning process, the learning process is no longer seen as a process where the teacher provides a lot of information to students through repetition and reinforcement, but the teacher only acts as a facilitator (Solihin, 2011: 45). The teacher's job is to direct students to ask questions, prove assumptions, and listen to opinions that differ from them.

Herman (Solihin, 2011: 46) states that problem-based learning fundamentally changes the view of the teaching and learning process from teaching teachers to learning learners. In this learning, students are required to work actively, cooperatively and be part of the group. Eggen (2012: 111) states that problem-based learning can be applied in classroom learning at two levels, namely first, students must solve a specific problem and understand the material related to it and second, students must develop problem solving skills and become independent learners.
2.4 Creative Thinking

Creativity is a person's ability to create something new, either in the form of ideas or works in combination with existing things, all of which are relatively different from what has been there before. Creative thinking is an exploration activity to generate new ideas that are different from existing ones.

As for the characteristics that characterize the ability to think, according to Guilford (Efendi, 2005: 89) one concept with another. There are five: fluency, flexibility, originality, elaboration and redefinition. Fluency is the ability to generate multiple ideas. Flexibility is the ability to develop a variety of solutions or approaches to problems. Originality is the ability to decide ideas in ways that are original, not clichéd. Elaboration is the ability to describe something in detail. Redefinition is the ability to view a problem from a perspective that is different from what many people already know.

2.5 Interactive Media

Multimedia Interactive can be used at various levels of education and various fields of study. The nature of this media is not only interactive but also multimedia in nature, there are complete media elements including sound, animation, video, text and graphics (Krisnadi, 2013; 34). Learning media are all forms of stimulants and tools provided by the teacher to encourage students / students to learn quickly, precisely, easily, correctly and not to verbalism (Hanafiah, 2008: 45).

Interactive multimedia can guide students / students thoroughly to master the material quickly and interestingly. Another advantage of interactive disks is that students can learn independently, not necessarily depending on the teacher / lecturer. The material taught on the disc can be directly practiced by students. There is a repeat function (repeat) which is useful for repeating material over and over again for overall mastery (Sugiarti: 2012,37)

2.6 Conventional Learning

Conventional teaching or traditional teaching is teaching given by teachers / lecturers to all students / students together with events that are commonly used. Making the teacher / lecturer a center, which means that the teacher / lecturer is the main driver of the teaching and learning process (Suryadi, 2009: 55). In this teaching, the teacher usually delivers teaching by lecturing by conveying information orally from a person to a number of listeners in a room (Suryadi, 2009: 52).

Lecturer-centered activity and communication that occurs in only one direction, from speaker to listener. In the lecture method, the teacher plays a major role in determining the content and sequence of steps in conveying the content or material to students. In this teaching, the teacher / lecturer dominates teaching and learning activities, defining the meaning and explanation of formulas which is done by the teacher himself (Suryadi, 2009: 57). Giving examples are given and done by the teacher / lecturer himself. The teacher / lecturer steps are followed carefully by the student / student. They only imitate the work methods and solutions done by the teacher / lecturer.

3 Methods

Development research that produces products in the form of learning strategies or research and development methods is a research method used to produce a particular product and test the effectiveness of the product (Sugiyono, 2013: 297). This study aims to develop a
learning strategy, namely the Application of Problem Based Learning Strategies in an Effort to Improve the Understanding of the Constitutional Court. Multicultural-Based Social Studies Learning in Post-Pendas UMP Students. This research procedure adapts the ADDIE development model which consists of five stages including analysis, design, development, implementation, and evaluation (Sugiyono, 2015: 200). The ADDIE model is chosen because the ADDIE development model is effective, dynamic and supports the performance of the program itself (Warsita, 2011: 7). The ADDIE model consists of 5 components that are interrelated and structured systematically, which means that from the first stage to the fifth stage in its application, it must be systematic and cannot be sorted randomly. These five stages or steps are very simple when compared to other design models. it is simple and systematically structured, so this design model is easy to understand and apply.

The research procedure used and the development according to the implementation of the SAVIR strategy were carried out in five stages, namely: 1) Analysis Stage (Analysis); 2) Design Phase (Design); 3) Development Stage (Development); 4) Implementation Stage (Implementation); 4) Evaluation Phase (Evaluation).

Place and Time of Research: 1) Place of research in UMP, 2) Time of research was carried out for 4 (four) months during lectures December 2019-July 2020, 3) Research subjects are students of Post basic educational Program study who teach courses Multicultural Based Social Studies Learning.

Data collection techniques, which were collected and developed were 1) interviews, 2) questionnaires, 3) tests, 4) documentation studies. Research instruments, collection and development instruments arranged in this study are: 1). Interview Guidelines, 2). Questionnaire sheet, 3). UAS Problem. Data analysis techniques used in this study are: 1). Quantitative Data Analysis: Analysis of strategy validity, analysis of strategy practicality, analysis of strategy effectiveness; 2). Qualitative Descriptive Data Analysis: Data collection, data reduction, data presentation, conclusion

4 Results and Discussion

4.1 How is the description of SAVIR strategy planning in Multicultural-Based Social Studies learning for Post-Pendas PPS UMP students

The description of the Multicultural-Based Social Studies Learning course is as follows: 1) Multicultural social studies education can be formulated as a form of awareness of cultural diversity, human rights and the reduction or elimination of various types of prejudice or prejudice to build a just and advanced community life, Education multiculturalism is also defined as a strategy to develop awareness of one's pride in one's nation (The pride in one's home nation); 2) Multicultural social studies education must be developed in Indonesia in line with the development of democracy as a buffer for the policy of decentralization and regional autonomy (Otda), which if it is carried out carefully will actually plunge us into national divisions (national disintegration and separatism); 3) To realize the models of multicultural education in Indonesia, it is necessary to consider the combination of existing models, multicultural education can include three types of transformation: (a) self-transformation; (b) school transformation and teaching and learning processes; (c) transformation of society; 4) In principle, multicultural education is education that respects differences, always creates structures and processes in which every culture can carry out expressions, tolerance is an attitude
of accepting that other people are different from us, education that respects and upholds the realization of cultural equality is a necessity for the world our current national education; 5) Multicultural social studies education, there is cultural equality, alternative means of conflict resolution, so that students are not uprooted from cultural roots, as a basis for developing the national curriculum, towards a multicultural Indonesian society; 6) Multicultural social studies education, a conflict study towards peace studies, such as how to: a) avoid extremism and primordialism; b) a portrait of ethnic conflict in Indonesia; c) Ethnic conflict resolution; d) the historical sins of the New Order; e) conflict resolution attempts to understand subjective culture; f) regional autonomy: Opportunities and Threats of National Integration; g) Peace Studies to assess Conflict; h) Portrait of East Javanese Ethnic Groups in the Era of Otda; i) Portrait of Ethnic Chinese Discrimination Cases; 7) The concept of material on multicultural-based social studies learning in general and basic, is still needed in the field at the level of implementation. So, the concept of this learning material is expected to be able to open a veil of understanding about: the theoretical concept of the multicultural-based social studies learning field; understand the emergence and theoretical orientation of the Multicultural-Based Semester Course Plan for Social Studies Teaching; using the theory developed in Multicultural-Based Social Studies Teaching; (8) Able to analyze and review the results of social studies studies based on the development of educational and multicultural theories.

4.2 How to improve the concept of Multicultural-Based Social Studies Learning in Post-Pendas students through the application of problem-based SAVIR strategies

Problem-based learning occurs in four phases, as follows:
Phase 1: Reviewing and presenting problems Lecturer / Teacher reviews the knowledge needed to solve problems and provide students with problems
- Attract students / students and attract them in the lesson
- Informally assess initial knowledge
- Provides a concrete focus for lessons
Phase 2: Develop Strategies students develop strategies to solve problems and the lecturer/teacher gives them feedback about the strategy
- Ensure as much as possible that students / learners use the approach to solving problems: problems that exist in Indonesia
Phase 3: Implementing the strategy
Learners apply their strategies while lecturers / teachers carefully monitor their efforts and provide feedback
- Give students / learners experience to solve problems
Phase 4: Discuss and evaluate results
Lecturer / teacher guides discussions about students' efforts and the results they get - Gives students / learners feedback about their efforts

4.3 How to increase the creative thinking skills of Post Pendas students through the application of the problem-based SAVIR strategy?

An understanding of the role of social studies education in multicultural education in Indonesia, that is, it is realized that there are problems with multicultural education in Indonesia. do not understand the broad meaning of Pancasila. In social education, the understanding is given that in the community, always side by side with different backgrounds, it is hoped that they can live in peace. Another aspect sometimes in reality 27 emphasizes unity and integrity
rather than raising awareness of a diverse society or as a pluralistic society. Multicultural policies from the Government are needed in relation to diversity. Furthermore, the existence of community policies can manage to be useful, promote a better life and can reduce prejudice from differences and reduce conflict. b. The Implementation of Multicultural Education In each country, there are different policies in developing multicultural education, this is related to whether or not education is suitable with the problems that exist in the country concerned. Several approaches to integrating a multicultural education teaching material include:

1) The contribution approach, this approach is characterized by historical events such as heroes from various different ethnic groups as well as various historical objects that can be used as learning media in accordance with developments in Indonesia

2) An additive approach, an approach that puts more emphasis on additional material, which is related to the main themes and concepts of a curriculum in relation to the structure, objectives and aspects of the basic characteristics of learning. Can be used as a support such as books, or others that do not change the curriculum material substantially.

3) The transformation approach, this approach changes the basic assumptions of the curriculum so that students can be competent in seeing various problems and issues that occur from various perspectives with different backgrounds.

4) The social action approach, this approach covers a wide variety of elements of the transformation approach, where students are required to develop actions related to the concept, issue or problem being studied. The goal is that students can criticize the social problems of learning fiber learning to decide a related policy, students are expected to get values, knowledge and skills that can be used to participate in social change. So that it is hoped that the forms of groups or groups of race, ethnicity, culture that were previously ignored can participate together in society (Banks, 1993). Direct and indirect expectations of social studies subject learning can teach knowledge and transmission of cultural values, good behavior so that they can have a big contribution to creating character in students and being able to become students who have better moral values. Some examples include respecting differences in religion, cultural and racial differences in society and complying with legal regulations that apply in the State. In class learning activities, for example, you can apply the discussion method so that students are more communicative and active, where they can mutually argue or argue from various different backgrounds so that mutual respect for these differences can be realized. In addition, student activeness can increase curiosity in obtaining the development of information on all sources that can be used as an addition to discussion, however the teacher must explain how to obtain this information to how it can be used for joint discussions.

Another method in social studies learning can apply learning directly to actual situations, such as social problem topics, which can be done by looking for real problems in the environment around the place of learning, then students are trained to be able to make decisions or provide solutions to these problems. Social studies education learning in multicultural education is expected to increase student participation or student contribution in solving various problems that exist around them related to the development of multicultural problems today. Social studies education plays a very important role in multicultural development, closely related to the current era of globalization. Social studies education in it provides learning knowledge about democratic values, culture, political science, history, law, philosophy, anthropology and sociology. Some of his social science presentations include; fellow living beings have the same rights and obligations in the recognition of the Indonesian State, the togetherness of a person who lives together in a particular area of society as well as between
regions. Furthermore, there is an orientation at the level of social welfare which is a dream for all human beings, and so on which relates to life together. In addition, social studies education is expected to be able to apply knowledge and skills, a positive attitude in accordance with the environmental conditions surrounding the development of science and technology. Multicultural insight is also very much needed in the current era related to developments in the era of globalization, competing in the development of education and technology and to reduce the emergence of discriminatory problems in learning activities in various fields of school to university. Thus, it is hoped that the integration of social studies education learning in multicultural education can contribute to creating a strong society in the midst of various developments in globalization and upholding the basic philosophy of the country, namely "diversity" so that a peaceful, harmonious community life can be realized even though there are differences and social studies education can be the driving force in the development of a more advanced, improved Indonesian education is better characterized by Indonesian culture.

5 Conclusion

The research objectives were, 1) The benefits of research, in general, the results of this study are expected to contribute thoughts to multicultural-based social studies learning and can be useful as an alternative to improve students' conceptual understanding and creative thinking skills in multicultural-based social studies lectures / learning through the application of the problem-based SAVIR strategy; 2) Practically the results of this research can be used as, input and consideration for planning and increasing understanding of concepts and the ability to think creatively in Multicultural-Based Social Studies learning also in other subjects, and students through the use and selection of strategies and learning models in lectures; the application of problem-based SAVIR strategies and students' thinking abilities after implementing the problem-based SAVIR strategy in the teaching and learning process; and a contribution of thought through educational research related to learning models, so that learning becomes more interesting, not boring and creates creative thinking; 3) With multicultural-based social studies learning, it is hoped that it can bring better changes from various cultures, ethnicities, ethnicities, different religions, which can instill awareness of students who have useful social values as a form of contribution in overcoming problems in the surrounding community in the future. So that the role of social studies for multicultural education can contribute to the improvement of the reality of life, with students / students having an attitude of mutual respect and accepting various differences, having a strong character, having moral values, having sensitivity to social conditions that require, prioritizing values value is not just knowledge.

References

Directions and Trends of Mathematical Education  
Research in Indonesia

RH Simanungkalit¹, Kartono², SB Waluya³, Rochmad⁴, Isnarto⁵  
{ricksimanungkalit@uhn.ac.id, hunter.rick89@yahoo.com}

Mathematics Education, Postgraduate, Universitas Negeri Semarang, Semarang, Central Java, 50229, Indonesia¹²³⁴⁵  
FMIPA, Universitas HKBP Nommensen, Medan, North Sumatera, 20234, Indonesia¹

Abstract: Mathematics education research has undergone very rapid changes, marked by  
the formation of many mathematics education research organizations and the availability  
of accredited and indexed research publications. The purpose of this study was to see a  
description of past and present research and to determine the direction and trends of future  
mathematics education research. This research is a literature study by examining 106  
articles that have been published in the Journal on Mathematics Education (JME-Sriwijaya Univ.) 2010-2017, then analyzed using descriptive analysis method. Past  
mathematics education research has been dominated by the issue of mathematics learning  
model / theory / curriculum design with a focus on primary education students as research  
subjects. Currently the research topic of mathematics education examines the media and  
learning technology with a study into the high-level thinking processes of students with an  
even subject. Future mathematics education research will also examine higher-order  
thinking skills which emphasize 4C (Four Cs: Creativity, Critical Thinking,  
Communication, and Collaboration) abilities.

Keywords: Mathematics Education Research Trends, Research Topics, Research Subjects.

1 Introduction

Mathematics education research is needed to help solve mathematics learning problems  
and provide new efforts and breakthroughs in developing mathematics education and learning.  
About research activities in mathematics education, this paper will describe the past, present,  
and future profile of mathematics education research to find out the trends and issues it has  
studied, especially in the past (2010-2014). A trend that is currently developing in 2014- 2017  
(the last three years) and an overview of future mathematics education research trends. The  
purpose of this study was to see a description of past and present research and to determine the  
direction and trends of future mathematics education research. It is hoped that this article can  
be a reference for researchers who will carry out research in the field of mathematics  
education, to get an overview of the direction and trends of the research.
2 Method

This research is a literature review by examining 106 articles that have been published in the Journal on Mathematics Education (JME-Sriwijaya Univ.) 2010-2017. The type of data in this study is in the form of secondary data obtained from the Journal on Mathematics Education (JME-Sriwijaya Univ.). The data that has been obtained are then analyzed using descriptive analysis methods. Descriptive analysis method is carried out by describing the facts which is then followed by a more in-depth analysis.

3 Results and Discussion

Mathematics education research is currently developing very fast; this can be seen from the many mathematics education research organizations such as the International Congress for Mathematics Instruction (ICMI), the International Group for Psychological Mathematics Education (IGPME), European Researchers of Mathematics Education (ERME), and so on. Furthermore, the results of mathematics education research are also disseminated through mathematics education seminars and conferences, such as the International Conference in Mathematics Education (ICME), the Conference of the European Research in Mathematics Education (CERME). In Indonesia, there is the National Mathematics Education Conference (KNPM). Apart from seminars and conferences, dissemination of research results is also carried out through journals, both in print and electronic (online), such as the Journal for Research in Mathematics Education (JRME), the Journal of Mathematics Teacher Education (JMTE) and in Indonesia has the IndoMS Journal of Mathematics Education (IndoMS JME), Journal on Mathematics Education (JME-Univ. Sriwijaya) and the National Journal of Mathematics Education (JNPM) which has been accredited by Dikti and DOAJ.

This paper tries to identify, describe, and discuss the profile of mathematics education research in the Mathematics Education Journal in Indonesia, with three discussion references, namely: (1) General topics/issues and problems under study, (2) who is the subject of investigation, (3) what approaches, and methods are used concerning the research problem.

3.1 Past Mathematics Education Research Trends

In past mathematics education research (2010-2014) in the Journal on Mathematics Education (JME-Sriwijaya Univ.) Can be seen in Table 1. Table 1 provides an overview of general topics/issues of problems that were studied by researchers from 2010 to the year 2014. Several researchers such as [1], [2], [3], [4] studied Problem Solving Ability, while research on the topic of Creative Thinking was conducted by [5], [6].

Research conducted by [7], [8], [9], [10] chose the topic of design or developing a Model/theory/ Curriculum. Meanwhile, studies on metacognition and spatial abilities have been studied by [11], [4]. Several researchers such as [12], [13], [14], [15] have reviewed
TIMSS and PISA. Meanwhile, research conducted by [16], [17], [5] examines topics regarding contextual problems and Realistic Mathematics.

<table>
<thead>
<tr>
<th>Nu</th>
<th>Topics Studies</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Model / Curriculum Design</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>Contekstual Problem / RME</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>PISA / TIMSS</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Metacognition / Spasial</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Problem Solving</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Creative Thinking</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 1. Topics Studies of Past Mathematics Education Research

From table 1. It can be seen that mathematics education research was dominated by the design of mathematics models/theories/curricula. The use of the mathematics learning model with the concept of a game dominates in past research. Judging from the research subject, mathematics education research used to take research subjects on elementary school students. Table 2 shows a recapitulation of the first mathematics education research subjects. It can be said that the first mathematics education research subjects focused on elementary education students. Only a small proportion of researchers take research subjects in secondary and tertiary education.

<table>
<thead>
<tr>
<th>Nu</th>
<th>Subject Research</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Elementary school students</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>Junior High School Students</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>High School Students</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>College student</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Teacher</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2. The subject of Past Mathematics Education Research

In the past, the research method for mathematics education used a qualitative approach. This type of qualitative approach is generally used in analytical research, such as research by [18], [19], [20], etc.

<table>
<thead>
<tr>
<th>Nu</th>
<th>Kind of Approaches</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Quantitative Approaches</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>Qualitative Approaches</td>
<td>21</td>
</tr>
</tbody>
</table>

Table 3. Research Approaches in Mathematics Education in the Past

3.2 Current Trend of Mathematics Education Research

In current mathematics education research (the last three years) in the Journal on Mathematics Education (JME-Sriwijaya Univ.) It can be seen in Table 4. Table 4 provides an
overview of general topics/issues of researchers’ problems from 2014 to 2017. Some researchers such as [21], examined problem-solving abilities. The ability to think creatively was studied by [22], [23], [24], [25].

[26] reviewed the topic of model/curriculum design; while studied topics/issues regarding Mathematical Literacy or PISA / TIMSS reviewed [27], [28], [29], [30] and [31]. The topic of contextual issues / RME was reviewed by [32], [33], [34], [35], and in mathematics education research in the last three years have studied a lot of mathematics learning technology/media including [36], [37], [38], [39], [40].

Table 4. Topics Studies of Current Mathematics Education Research

<table>
<thead>
<tr>
<th>Nu</th>
<th>Topics Studies</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Technology / Media</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>PISA / TIMSS</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>Creative Thinking</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>Contextual Problem/RME</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Problem Solving</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Model/curriculum Design</td>
<td>2</td>
</tr>
</tbody>
</table>

Judging from the research subjects, mathematics education research now tends to be balanced in choosing research subjects at the primary and secondary education levels. Table 5 shows a recapitulation of the first mathematics education research subjects. What is interesting in the research of mathematics education in the last three years is selecting teachers as the subject of mathematics education research. This indicates that it can be said that the quality and professionalism of teachers also influence the quality of education in Indonesia. This is in line with [41], [42] by 2030, all governments ensure that all learners are taught by qualified, professionally trained, motivated and well-supported teachers”.

Table 5. Subject of Current Mathematics Education Research

<table>
<thead>
<tr>
<th>Nu</th>
<th>Subject Research</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Elementary school students</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Junior High School Students</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>High School Students</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>College student</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Teacher</td>
<td>10</td>
</tr>
</tbody>
</table>

Research methods in mathematics education research now use a more quantitative approach. This quantitative approach is generally used in an experimental study by applying new techniques or new learning technologies.
Table 6. Research Approaches in Currently Mathematics Education

<table>
<thead>
<tr>
<th>Nu</th>
<th>Kind of Approaches</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Quantitative Approaches</td>
<td>26</td>
</tr>
<tr>
<td>2</td>
<td>Qualitative Approaches</td>
<td>15</td>
</tr>
</tbody>
</table>

2.3. Future Mathematics Education Research Trends

Future research trends in mathematics education will be influenced by developments in science and technology globally. Students must compete in a global society in the current information age so that students are required to have Creativity, critical thinking skills, communication, and collaboration, which is better known as the acronym 'Four Cs' [43], [44]. Through educators, schools must be able to complete 4C (Four Cs) skills to prepare their students as responsive and able to face global competition. Students will also dominate research subjects in mathematics education research in the future at the primary education level. This is consistent with the thought that when students are at the elementary level, it is the best time to develop their understanding and thinking about mathematics. Mathematical literacy is still a significant challenge in primary mathematics education. Mathematical literacy for all young people is the goal, and the fundamental priority of mathematics taught during primary education [45]. This is because Indonesia's achievements in the PISA and TIMSS assessments are still far from expected.

Meanwhile, [46] conveyed the three most significant challenges in mathematics education: mathematics, the role of mathematics in society (the part of mathematics in society), and equality in mathematics education. [44] says that math work is about problem-solving, reasoning, curiosity, joy, and not just following procedures to get answers; the role of mathematics in society is meant that all groups must achieve the need to see mathematics is a daily human activity, while equality in mathematics education is intended for all The targets in mathematics education, no one should be left behind. This is in line with the Incheon Declaration, which states that inclusion and equity in and through education is the cornerstone of a transformative education agenda [47].

4 Conclusion

The trend of mathematics education research develops, along with the development of science and technology. The direction of mathematics education research is in line with new findings in mathematics education. Past research on mathematics education, which was dominated by curriculum design/models, included learning theory changing towards mathematics learning technology/media and research on students' higher-order thinking processes. Future research in mathematics education will also examine higher-order thinking skills and emphasize the 4-C (four Cs) ability. This is due to the demands of globalization needs today for students' abilities. The subject of mathematics education research is currently more developed than that of mathematics education in the past. Where in current mathematics education research, teachers become new research subjects, which will also be in line with the
trends in mathematics education research in the future. Types of mathematics education research approaches will also develop over time. In the past, mathematics education was dominated by qualitative methods. In contrast, current research is dominated by quantitative techniques. Future research in mathematics education provides a more significant opportunity to use qualitative and quantitative research types (mixed method).

References


Students’ Mathematics Representation of the Statistics: A Case Study

Alfian Eka Utama¹, Sufyani Prabawanto²
{alfianeka25@upi.edu¹, sufyani@upi.edu²}

Mathematics Education Study Program, School of Postgraduate, Universitas Pendidikan Indonesia, Jl. Dr. Setia Budi No. 229, Bandung 40154, Indonesia ¹, Mathematics Education Department, School of Postgraduate, Universitas Pendidikan Indonesia, Jl. Dr. Setia Budi No. 229, Bandung 40154, Indonesia ²

Abstract. The purpose of this study is to investigate students' mathematics representations of the statistics. This research is qualitative research with a case study design. The subjects of this study were five 9th graders. The data were collected using the student's worksheets and interviews. The students' mathematics representation was seen through the statistics problems' results; then, we continued with the interview. The findings of this research indicate that the student's high-ability can represent their answers visually in the form of bar, line, and circle diagrams well. Meanwhile, students with low-ability present their work differently on line diagrams drawn upside down, and unanswered circle charts because they have difficulty calculating and measuring percentages in circles, so they are not able to express their ideas visually optimally. For verbal representations, each student presented his answer briefly, which only wrote down the final result of the answer being asked without providing any information. Then for the ability of symbolic representation, students can represent their answers symbolically in algebraic form and solve the problems given systematically.

Keywords: mathematics representation, statistic

1 Introduction

Representation is the translation of a problem or idea in a new form, including images or physical models, into symbols, words, or sentences [1]. Mathematical representation is an expression of mathematical ideas displayed as a model of a problem, which can be presented in the form of tables, pictures, verbal or mathematical symbols [2]. In mathematics education, representation is significant in simplifying and solving mathematical problems [3]. Besides, the word is notable both as a tool that supports reflection and as a means of communicating students' mathematical ideas [4]-[6] both verbal or numeric [7]. Representation is one of the standard mathematics learning processes that students must master [1]. The ability to express is one of the essential skills to be developed and must be owned by students.

[8] state that tables, pictures, graphs, mathematical statements, written text, or a combination are all kinds of representations that are often used in communicating mathematics. [9] the name consists of several forms, graphical models, verbal presentations, diagrammatic terms, and mathematical representations. Mathematical expressions can be represented as visual and non-visual representations. Visual representations include graphs, tables, pictures, or diagrams. Then non-visual illustrations include numerical drawings and mathematical equations or mathematical models. The representation ability can be seen clearly whenever visual and
numeric representations are used in terms of ratio, proportion, and percent [10]. The ability to represent cognitive activities according to [11] includes visual representations (making images of real-world situations clarifying problems and facilitating their solutions), verbal representations (answering questions using words or written text), and symbolic representations (problem-solving involving symbol).

Some of the results of research in mathematics education on representation, on cube and block material [6] circle [12], Pythagoras [10] algebra [13] [14]. Previous research has found that many students have poor mathematical representation skills [6] [10] [15]. One of the mathematical materials that require good representation skills is statistics. In statistics, students are required to explain data presentation techniques in the form of diagrams or tables or graphs, then interpret the meaning of charts or tables or maps, and find solutions from centralizing data [16]. This study aimed to determine students' mathematical representation in statistical material, which includes visual name, verbal expression, and symbolic representation.

2 Method

This research is qualitative research with a case study design. A case study is a strategy taken by researchers and understanding the object under study specifically and deeply in a case through relevant data [17] [18]. The issue in this study is the mathematical representation of students in statistics material. This research was conducted in September at a middle school in Mataram, West Nusa Tenggara. There are five grade nine students, as subjects in this study. All subjects had previously studied the statistic material in 7th and 8th grade. Subjects were selected based on mathematics achievement as well as recommendations from mathematics subject teachers. Two students, AS and BA, have low levels, two other student’s RF and MD, have moderate mathematics achievement, and one student CK has high mathematics learning achievement. The data were collected using worksheets and interviews with students. The research was conducted during one meeting for all students within 40 minutes. Each students was interviewed about the answers they gave in text to clarify the results of their oral representations. why do they answer as written or have different meanings about the given representation. First, the students were evaluated for twenty minutes using statistical problems; students' answers are analyzed; then, the interview was conducted for twenty minutes. There are four problems related to the statistics presented in this study. These problems are taken from middle school mathematics textbooks. one concern was to see the ability of visual representation, one issue to see the power of verbal expression, one question to know the capacity of symbolic representation, and another to see the combination of representations visual, symbolic and verbal.

3 Result and Discussion

There are four problems related to the statistics presented in this study. In the first problem, students are asked to give data in the form of bar, line, and circle diagrams to see their visual representation ability. In the second problem, students are asked to describe their observations on a graph to see the student's verbal representation skills; in the third problem, students are asked to solve a daily concern to see the symbolic representation ability, and in the fourth
Problem

Problem 1

This problem presents data in the form of a story text problem. Students are asked to convert the data into bar charts, graphs, and pie. Solving this problem will maintain the ability of students to visual representations.

Fig. 1. Solution problem one by a student BA

Fig. 2. Solution problem one by a student MD

In this problem, the subjects CK, RF, MD, and AS can visually represent the given data, turning the data into bar and line charts. However, BA subjects present bar and line charts in different ways, see figure 1. Based on the interview, BA subjects only pay attention to the numbers in the data. In the circle diagram of CK students with high ability and moderate RF ability to visually represent, MD represented the data into a pie chart but was less than perfect.
See Figure 2. BA and AS did not answer. Based on the results of the interview, MD only paid attention to the numbers in the data. BA and AS said they could not show a representation because of the difficulty of calculating and measuring percentages in circles.

**Problem 2**

In the second problem, students are given a line diagram, and then students are asked to analyze the data.

![Fig. 3. Solution problem two by student MD](image1)

![Fig. 4. Solution problem two by student CK](image2)

![Fig. 5. Solution problem two by student AS](image3)

![Fig. 6. Solution problem two by student BA](image4)

Students are given a line diagram; then, students are asked to analyze the data in written form. In this problem, all students can answer well. CK and MD can represent the results of their thoughts both verbally, in writing and orally from the diagrams well, see figures 3 and 4. BA represents their answers in an incomplete report. US and RF represent their answers in writing. They only answered with numbers without writing a complete description of the
diagram. The representation ability of students is still not good at conveying their ideas in writing [13]. Based on the interviews, CK, RF, MD, SA, and BA students were able to represent them orally well.

Problem 3

In problem 3, students are given a mathematical problem using a daily life situation; then, students find a solution to the problem mathematically by symbolic.

![Fig. 7. Solution problem three by student RF](image1)

![Fig. 8. Solution problem three by student AS](image2)

![Fig. 9. Solution problem three by student CK](image3)

All students can answer this problem. Student RF represents the answers by first symbolizing in algebraic form the question given, see figure 7. Based on the interview, symbolic out the situation can make it easier for him to find a solution to the problem. Student AS does not represent it symbolically, only describe it in words. Student representation skills are the key to successful mathematical problem solving [19]. Meanwhile, student CK answered by directly looking for the value of the questions given.
Problem 4

Fig. 10. Solution problem four by student RF

Fig. 11. Solution problem four by student AS

Fig. 10. Solution problem four by student BA
In four problems, students were given questions in diagrams; then, students were asked to find solutions to these problems. Student BA only represents answers in numerical form, without explaining in writing, see figure 12. Based on the interview, students only care about the final answer. Student RF represents their answers by describing the amount of data to find solutions to the problems given. Based on the interview, describing the data will make it easier for him to find solutions representation is very important in simplifying and solving mathematical problems [3]. Student AS represents a solution by adding up lots of data and then describing it symbolically and mathematically.

4 Conclusion

From this study, it can be concluded that student’s high-ability can represent their answers visually in the form of bar, line, and circle diagrams well. Meanwhile, students with low-ability present their work differently on line diagrams drawn upside down, and unanswered circle charts because they have difficulty calculating and measuring percentages in circles, so they are not able to express their ideas visually optimally. For verbal representations, each student presented his answer briefly, which only wrote down the final result of the answer being asked without providing any information. Then for the ability of symbolic representation, students can represent their answers symbolically in algebraic form and solve the problems given systematically. We suggest continuing research on how students represent mathematics in more subjects.

References


The Role Women in Improving Islamic Perspektif of The Current Context

Ana Andriani¹, Wakhudin²
{ana.andriani@gmail.com¹, wakhudin@ump.ac.id²}
Universitas Muhammadiyah Purwokerto

Abstract. This paper intends to interpret the role of women in the present context in the Islamic perspective. The role of women described as "pillars of the state" is a huge force to raise and educate their children, accompany their husbands on the one hand, and a woman who works in the public sector on the other. Women must raise various problems faced, both in family matters, their roles as children, mothers and wives, as well as issues related to their roles outside the public sector. All need wisdom to solve it. Modern women living today have much better freedom than the era of R.A. Kartini. In fact, due to advances in science and technology, women have a greater chance than men in competing for employment. So many jobs that were previously dominated by men can now be done by women. But all parties must also be wise in dealing with this gender issue. Because, women are faced with domestic duties, so that they do not always work in the public sphere. In the matter of polygamy, Muslim women do not need to worry because this marriage is carried out in a certain context, if all parties are fine. If you are worried that something is wrong, then Islam recommends marrying only one woman.

Key words: women, Islam, global era

1 Introduction

The existence of Indonesian women since entering the 21st century has become increasingly visible, surpassing the achievements of men. This phenomenon is seen in educational institutions. Look at the achievements of women, out of the top 10 in the ranking of outstanding students in the class, 9 of them are women. Only 1 male who achieved. This is usually not the 1st, 2nd, or 3rd rank, but always above the 5th rank. The top five achievements are mostly dominated by women. This symptom is probably due to the advancement of science and technology.

Advances in information technology, in particular, "drown" boys in the fun of playing gadgets, both for playing games, chatting, social media, and the various applications provided by technology. As a consequence, the young male generation tends to ignore learning programs in schools. Meanwhile, women are more diligent in their work, including paying more attention to class and school program subjects. Every class activity is always followed carefully. Homework is done well, and the teaching and learning process in the classroom is followed proportionately.

Advances in information technology do bring new "delinquency" for students, both male and female students. The delinquency that often occurs in men is that they are deprived of their attention to play with information technology. If children use technology for productive activities, it really doesn't matter, it can even provide added value, because it can be a place to
express creativity and innovation. But what happens in general, boys use technology for counterproductive activities, such as excessive chatting, playing games indefinitely, and accessing pornography. Uncontrolled counterproductive activity causes boys' achievement in class to stagnate in the lower ranks.

Symptoms of "delinquency" in girls are almost the same, immersed in the sophistication of science and technology. But women prefer a different segmentation, for example, they prefer Korean dramas. Liking K-Pop is actually a normal symptom, but spending the whole night watching drama fragments makes them physically tired during the day, so they are not ready to study in class. This symptom is mostly found in female students, but not as many as male students who spend their evenings "cracking" gadgets and various internet-connected devices for counterproductive activities.

As a further result, women are more likely than men to enter the world of work, especially when entering jobs that require more intellect. The intelligence that is reflected in the classroom is also reflected in the intellectuality of the test results when entering the world of work. Thus, in various recruitments for new hires, the Human Resources Department recruits more women than men if the test measures used are cognitive and soft skills. The number of new employees between men and women is no longer balanced, for example, 50%: 50%, but there are always more female human resources (HR) than men.

Symptoms of the increasing superiority of women are also seen in the world of work that requires masculinity. Jobs that in the past were mostly done by men were slowly being taken over by women. Workers at Filling Stations, for example, in the past were mostly men. But now they are dominated by women. In fact, many of them work night shifts. Likewise parking attendants or other manual laborers, women are increasingly filling these jobs.

When working, women also adjust more easily than men. The combination of intellectuals with their soft skills causes women to be more flexible at work and able to solve various problems better. But women workers do not have problems. The main problem for women is when they are married. Women have difficulty dividing their time between taking care of their family, both helping their husbands and taking care of their children, and working in the office. Some women have to work very hard to allocate time for family and profession, but not a few of them give up on the situation by choosing a family and neglect work in the office. In fact, many of them choose to resign from work to take care of the household and choose to live with their children.

This symptom indicates a change in gender relations between men and women, in which women increasingly dominate various aspects of life. The number of female births that is more than that of men is one of the causes, in addition to a change in work ethic between the two sexes. This phenomenon is also evidence that gender equality in Indonesia is increasingly evident, if it cannot be said that women are increasingly taking over men's opportunities.

This article at the beginning focuses more on the relationship between men and women from the perspective of feminism. Meanwhile, the next section focuses on the role of women in an Islamic perspective, especially in examining women's activities today. In the end, this paper invites all parties to find a compromise of thought between glorifying women according to the morals of the Islamic religion on the one hand, also providing opportunities for women to have careers, but still providing opportunities for men to take part in their world without having to compete with labor woman.
2 Literature

Allah SWT created everything in pairs. There are day-night, morning-evening, dark-light, left-right, up-down, life-death, and also men and women. All of this is created for a harmonious relationship. Logically, if there was only one side, no other side, that would be very unlikely. As on two inseparable sides of the coin. The Quran repeatedly mentions partners in the botanical realm, it also mentions partners in a more general way, and with indefinite boundaries.

“Glory to God who has created pairs all both from what the earth has grown and from themselves and from what they do not know” (Alquran Surah Yaa Siin, 36: 36). From the very beginning, Allah created human beings so that a pair-and-partner relationship between Adam and Eve could be realized. Furthermore, the male pairs with the female, the sky pairs with the earth, the sun pairs with the moon, the day pairs with the night. Islam teaches, sin pairs with reward, heaven pairs with hell, satan pairs with angels.

With regard to the existence of women and men, a harmonious partner is ideal. They complement each other. “It is made beautiful in the human (view) of the love of what is desired: women, children, wealth of gold, silver, selected horses, livestock and fields. That is the pleasure of living in the world, and with Allah is a good place to return (heaven)” (Surah An-Nisa: 1).

2.1 Women of Inspiration

In human life, women are always an inspiration, the story of Jeanne d'Arc in the 15th century in France, is one of them. How she became a fire of enthusiasm for the French nation when her country was occupied by Britain. The issue of being a spreader of witchcraft, then finally being burned alive, making her a holy woman. Women cannot be separated from the society in which they live, and women are an inseparable part of an entity called family. Managing the household and partnering with the husband in the household are important roles for women in general, having an important position as intellectuals, to borrow Edward Said's thoughts in his book The Representation of Intellectuals, women as intellectuals are able to say what they think is true, whether or not they are in accordance with the thoughts of the authorities. It would be a mistake to know what to say but avoid saying it, and should never be devoted to those in power. Another unique role of women is to have the task of carrying out duties in the household and in the public sphere.

Thus it becomes clear that the position of women in the situation of living together in a country is very important. Women as the pillars of civilization have the ability to be able to reconstruct human civilization in accordance with the corridors outlined by God to them, of course by giving a touch of religious education so that their existence, potential and goodness can contribute to improvements in the formation of civilization and be able to support it when she is the first educator of mankind.

The problem today is that women face quite serious obstacles. The dual role in the public sector, which seems to be the culture of society today, has huge consequences for its continued role in the domestic sector. The existence of women outside the home often interferes with their activities in their families. In fact, the public space is wide open. Meanwhile, the reality of the community (silence majority), which is starting to be apathetic and apolitical, can be found anywhere. Emancipation that is able to bring out the extraordinary potential of women can be accepted by society without having to sacrifice the main role of women in the family.
2.2 Emancipation, Resistance to Polygamy

One of the Indonesian female figures who became a source of inspiration is R.A. Kartini. She is the daughter of R.M. Adipati Ario Sosroningrat, Regent of Jepara, was born on April 21, 1879 in Mayong, Jepara Regency. Kartini is the daughter of her father's second wife. Until the age of 12, Kartini was still allowed to go to school and leave the house by her father. However, in 1892, she had to undergo seclusion, which at that time was a Javanese custom that was applied to adult women. For four years Kartini was confined in seclusion, and after being released from that confinement, she faced the obligation to marry a man she did not know. He was R. Adipati Djojo Adiningrat, the Rembang Regent who was already married. Actually, Kartini was very much against such marriage customs, but she was helpless, because “just obeying” was a value that Javanese women had to adhere to, and marrying an unknown man was a custom and a must for Javanese girls at that time.

Kartini lived in the earliest phase of Indonesian nationalism. Kartini's sense of nationality was only fought for by herself, without the support of mass organizations that did not yet exist at that time. Awareness of the fate of their nation can be listened to through resistance to polygamy, which was then entrenched among the Javanese aristocrats. In a letter to her best friend, Zeehandelaar, Kartini expressed her feelings as follows:

Once in a while I can't put love. If it's going to make love, in my opinion, there must be respect first. I have no respect for Javanese youth. How can I respect someone who is already married and who is already a father, but because he is satisfied to have married the mother of his children, bring another woman into his house, the woman whom he marries legally according to Islamic law? Who doesn't? And why not? It is not a sin, and it is not a reproach. Islamic law allows men to keep four women. Even though people say a thousand times that having four wives is not a sin according to Islamic law, I say that it is a sin. Anything that hurts others, is sin in my opinion. What is the miserable punishment that a woman must suffer, if her man returns home with another woman and that woman must be recognized as his legitimate male wife, and must be accepted as a rival? That woman can be tortured, hurt for the rest of her life to her heart's content, but if he does not want to free her again, that woman can only cry as high as the sky to ask for rights, nothing will get.

Do you understand now why I hate marriage so much? Work as low as I want to do it with a big heart and earnest, as long as I do not have to marry, and I am free. Stella, you know what a sad heart. My heart really wants to do something, but I feel really powerless to do so.

You ask whether I was originally confined in four thick walls. You think I live in an eggplant or something. No, Stella, my prison is a large house, with a large courtyard around it, but around the courtyard there are high walls. This wall is our prison. How big is our house and yard, if we always have to live there, it feels too tight. I remembered how I, because of infinite despair and sadness, then threw my body over and over again at the ever-closed door, and on that cruel stone wall. Where do I go, every time I break my way by a stone wall or a locked door.

Our whole world of bumiputera will certainly change too. The time of change is predestined by God, but what? That's the problem. We cannot speed up the time of change. Comrade, we are saying here, it would be nice if we slept first for a hundred years, and when we wake up again, then we feel we fit the situation at that time. (Excerpt from Kartini's Letter to Ms. Zeehandelaar, November 6, 1899. Quoted from R.A. Kartini, After Darkness Is Out of Light, Jakarta: Balai Pustaka, 1949, translation by Armijn Pane).

However Kartini lamented and opposed the custom, the confinement of customs and traditions in her family was stronger. She had to give up. On November 8, 1903 Kartini had to
marry the Regent of Rembang, R. Adipati Djojo Adiningrat. On September 13, 1904, her son was born, and four days later on September 17, 1904, Kartini died.

3 Method

3.1 Conflict Due to Religion

At the time of Kartini's life, conflict over religion seemed to be prevalent in Javanese society. This condition can be seen from Kartini's outpouring in her letter to Zeehandelaar as follows:

Religion means that it will give mercy to humans, so that there will be friendship with all God's creatures. All of us brothers and sisters, not because we are the same as the father of a human birth, but we are all creatures of a Father, to Him, who reigns in the heavens. O my Lord, there are times when I wish, it would be nice if there was no religion. Because, that religion, which actually has to unite all the servants of Allah, has always been a source of strife and division, has been the cause of fights, murders which are very horrible and cruel. People who are a thousand opposites, because they have different ways of serving the One God. People who are very merciful, very sadly divorce, because different places call to God. God that too; stands the wall of a compassionate heart. Is it true that religion is a blessing for humans? I often ask myself, hesitating. Religion must keep us from sinning, but how many sins do people commit in the name of that religion? (Extract from Kartini's letter to Ms. Zeehandelaar, 6 November 1899).

3.2 Education for Indigenous Women

Kartini also fought for the improvement of the lives of the native people through women's education. Below are Kartini's thoughts about the importance of education for indigenous (bumiputera) women:

I have been thinking about education for a long time, especially in the last few times. I see education as a noble and sacred obligation. I see it as a crime, if I carry out the educational effort, but I don't have the full skills yet. It must be evident first, whether I am able to become an educator or not. In my opinion, education is education of mind and spirit. It feels like an educator's obligation has not been completed if she is only educating her mind. She must also work to educate minds even though there is no law that obliges him to do so. I ask myself, can I? I still need to be educated?

With all my heart I confirm the thoughts of your husband, Madam, which is written in a circular about a teaching case for bumiputera girls: “Women are become pillars of civilization teachers!” Not because women are considered capable of that, but because I truly believe that from that woman a great effect will arise, both deteriorating and improving life. It is she who is more able to help promote human morality.

It was from women that humans first received education. It is in her day that the child learns to feel, think and speak. Increasingly, I have come to know that this initial upbringing is not insignificant for human life in the future. How could the mother of a bumiputera be able to educate her child, if they themselves are not educated?

That is why I am very excited about the noble intention of providing education and teaching for native girls. I have known for a long time, that this is what can change the lives of us sad
native women. Teaching these girls not only to women will bring grace, but also to the entire bumiputera society (Extract from Kartini's letter to Mrs. Abendanon, January 21, 1901) translation by Armijn Pane).

Thus Kartini, with no awareness and understanding of the concept of nationalism, she cared about and had a very high sensitivity to aspects of the life of the native people that had to be improved and enhanced.

4 Result and Discussion

4.1 Meaning of Gender

The word gender means differences in roles, functions, and responsibilities between women and men which are the result of socio-cultural constructions and can change according to the times. This gender issue has an impact on status, function, role, and responsibility, to the extent that it concerns men's and women's activity spaces in society. It is as if there is discrimination against the roles of women and men, and gender injustice which affects the existence of women themselves. So women's obsession is gender equality.

Gender is often identified with sex. Gender is very different from sex. Gender is understood as a gift from God Almighty with its character. Etymologically the word “gender” comes from English which means “gender” (John M. Echols and Hassan Shadily, 1983: 265). The word “gender” can be defined as “the visible differences between men and women in terms of values and behavior” (Victoria Neufeldt (ed.), 1984: 561).

Gender can be defined terminologically as cultural expectations of men and women (Hilary M. Lips, 1993: 4). Meanwhile, according to Showalter, gender is the differentiation of men and women seen from the socio-cultural construction (Elaine Showalter (ed.), 1989: 3). Nasaruddin Umar (1999: 34) explains that gender can be used as an analytical concept that can be used to explain something. Women’s Studies Encyclopedia more explicitly explains that gender is a cultural concept that is used to distinguish the roles, behaviors, mentality, and emotional characteristics of men and women that develop in society (Siti Musdah Mulia, 2004: 4).

Gender as an analysis tool is generally used by adherents of the social science school of conflict, which focuses on structural and system injustices caused by gender. The problem and need to be challenged from their analysis using gender analysis is the structure of “injustice” caused by gender roles and differences. Feminism is a word that has a meaning as a movement that starts from the assumption and awareness that women are basically oppressed and exploited, and there must be efforts to end this bad behavior towards women.

Mansour Faqih views this issue by highlighting that gender injustice is caused by four things:
1. Marginalization of women (green revolution which prioritized men over women).
2. Subordination of women by men.
3. Stereotypes (wrong views) between women and men.
4. The existence of violence in household.

There are many concerning cases related to women, apart from the four factors above, trafficking, contract marriage, are other things that deserve attention. This is due to powerlessness, low education, and weak empowerment of women's potential. Gender equality is a condition that is equal and balanced between men and women in gaining access (opportunities, opportunities) in various aspects of life.
Feminism is an understanding and a movement that demands full equal rights between men and women. According to Fakih (1996: 78), feminism is generally a movement that originates from the assumption and awareness that women are oppressed and exploited, so there must be an effort to end oppression and exploitation.

Feminism emphasizes equal rights between women and men, both in employment, income, and equal opportunities in various ways. Like other schools of thought and movements, it is not single, but consists of various ideologies, paradigms and theories whose orientation is focused on fighting for the fate of women. So it is feminists who faithfully proclaim this gender equality.

Feminism can be categorized as an ideology, because now it is no longer a mere thought movement, but has developed into a movement that has a structural-conflict approach. In the structural-conflict approach, everything related to gender relations can be seen and placed in a contradictory and antagonistic context. The other side of feminism is the awakening of the awareness of injustice towards equal dignity and honor with men as God's creatures who are born equal.

4.2 Women in Islamic Perspective

Allah SWT gives intelligence to every woman. Therefore, it is to women that children are entrusted. God does not necessarily give such a big mandate, if women do not have extraordinary potential. Women should have a strong identity, so that they are able to carry out their duties properly. Mother is a nickname for women who usually have children, are already married, or are educators, also for certain age categories (for some women who feel young? There is a feeling of uncomfortable being called mother, even though they are physically adults).

For the first vocation, mother is a printer from an early generation, cannot be replaced by anyone. Even by the best and most expensive schools. So women are creatures full of potential that Allah SWT prepared to form the next generation. Being a mother today is not easy, with the times that seem endless, as well as the view of society today in seeing the mother figure, is faced with a dilemma.

“Heaven on the soles of mother's feet” becomes a series of sentences filled with the meaning that the task of women is so noble in living life on this earth, whether as children, wives, mothers, as well as in other roles. Of course this is a form of respect for women. And Islam deeply glorifies women.

Islam has a view of women by placing them so high and respect. Women also have the right to do whatever they want, as advised by the Prophet. “Give alms, O women, even from the jewellery you wear”. This is proof that women still have property rights. They are free to spend their wealth as they wishes.

This statement breaks the opinion of feminists who advocate gender equality, that women are imprisoned in an Islamic perspective. In a different portion from men, women have got a noble place. So without the need to herald gender equality, women have got it. The problems faced by women today, are that women able to divide their duties, roles and responsibilities so that they can carry out their duties properly? This condition makes most women stifled if they only live at home, work as a housewife as if they are not prestigious, so on the pretext of self-actualization, economic conditions, to being bored at home, the role outside the home is taken. This is legal, if women take part in roles outside the home, as long as they remain in accordance with their nature. Interpret the sentence that Allah SWT made humans as caliphs on earth, not only men who got the task as caliphs, but all humans. Men and women without exception, through intelligence, the function of the caliph is able to carry out it.
Concerns that women will not be anxious in carrying out their roles, women must be able to understand self-concepts. Where it comes from, what it was created for, where it will return, need to be deeply understood. Adequate education, understanding of roles, functions, status, and responsibilities as well as time management is very helpful in overcoming existing problems. So gender equality no longer needs to be voiced, because Islam has already implemented it.

4.3 Harmonization of Women and Men

Finding a girl who is secluded when entering adulthood today is very difficult, maybe not even there anymore. Likewise, women who are forced to marry men who do not know are getting smaller. There are still, but not many of them. Even if there is a forced marriage, it is usually the result of family problems, not because of a habit like the era of RA Kartini. If Kartini says, “After darkness, light rises”, then today the Indonesian nation is in a period of bright light. Even so bright that it looks dazzled.

Yes, women now live no longer confined, but free as birds flying wherever they want. Even so free, women today are free to express their feelings without hesitation. Even when it comes to love, women express their feelings before men. In the past, women tended to be passive when it came to love. They wait for men to confess their love first. After there is confirmation from men, women then give responses commensurate with the love given by men.

In fact, in some cases, women are more aggressive in chasing the men they like. Women claim to fall in love first than men convey it. Maybe she got the love back from him, maybe she didn't. But the behavior of aggressive women is increasingly prevalent these days. Maybe they are influenced by the soap operas they often watch on television. Maybe this condition has not been encountered by women in the past, so that women generally behave passively. In the past, women who were aggressive were called rude.

Which is better, a passive woman who accepts whatever circumstances are given, or an increasingly expressive, aggressive woman who can say whatever she wants? Both are good as long as there is a sense of responsibility. A woman who is passive must accept the consequences if she gets a boyfriend from a boy she doesn't like, because she doesn't reveal who is actually the man she doesn't like. On the other hand, an aggressive woman should not be disappointed if the man who is being chased has a wife or girlfriend, so that he does not want to choose another woman. What is more precise is, to be passive to maintain politeness. Men who love women will usually chase women who are polite and careful, not women who are aggressive to him.

When the situation is very important, women must also have the courage to convey their ideas, not just be silent. But even if they do talk, women don't need to talk excessively.

Apart from that, the freedom that women have, which men also have, is not used arbitrarily for counterproductive activities. Lesbian, gay, bisexual, and transgender sex can not be tolerated simply for reasons of freedom. This is because freedom means that there is a limit, there is a limit to the freedom of others. Free does not mean free to be damaged or destroyed. Meanwhile, sexual relations between lesbian, gay, bisexual, and transgender people are intrinsically damaging to humans and humanity. Having children through the relationship of a man and a woman is common, and it is only possible by having sex between a man and a woman. Beyond that it is impossible.

Although the relationship between man and woman is normal and will produce offspring, their relationship must be legal. The legal relationship between a man and a woman in Islamic perspective is marriage, which is a contract between the guardian and the groom. This ritual is a handover of responsibility from parents as guardians to the man who becomes the husband. Islamic fiqh law allows guardians (parents) to marry off their children to anyone. But in Islam,
marriage is not just a legal issue, it also concerns ethics and morals. Although parents are free to marry their children to anyone, men who are matched must be in balance with the daughter they marry, so that it benefits them.

Islamic law also allows men to marry four women, as complained R.A. Kartini. But again, the issue of marriage is not just a legal issue, but also concerns ethics and aesthetics. The legal basis for allowing a man to marry more than one woman is the Koran Surat An-Nisaa verse (3) which means, “And if you are afraid that you will not be able to be fair to the (rights) of an orphaned woman (if you marry her), then marry a woman (other). ) that you like two, three, or four. But if you are afraid of being unfair, then (marry) just one person, or the slaves you have. This is closer to non-persecution.” (Surah An-Nisaa, 3).

The above verse allows a man to marry 2, 3, or 4 women. But this verse also gives a signal about the possibility of being unfair, or at least if all parties are concerned about injustice. If both men and women are worried about injustice, the solution is to marry only one woman. At best, if there was still slavery, men could have sex with their slaves. Married with only one wife or with a slave has the opportunity for peace, without domestic fuss. That is, Islam provides an opportunity for polygamy to occur, but in certain situations, it suggests that it is enough to marry one wife or monogamy. Both polygamy and monogamy must all be adapted to the context of the husband and wife situation, not done arbitrarily.

Absolutely rejecting polygamy is not a solution to creating justice. In fact, rejecting polygamy means approving injustice. When the number of women is more than the number of men, then polygamy is a solution. With polygamy, all women get the opportunity to marry the man they love. But if polygamy is prohibited, then there will be injustice, because there are some women who are happy to get husbands, but there are others who cannot marry forever. In addition, in certain situations there are people who are so rich, but some others experience poverty. Marrying a woman to help others is part of goodness, even if you are a second, third, or fourth wife. But again, if polygamy causes no benefit, then they are advised to marry only one woman.

5 Conclusion

Women in their lives have dual roles, as wives and mothers. The two roles of women cannot be replaced by men. Pregnant women, giving birth, and breastfeeding then educating their children is a series of tasks that require extra attention. Such a heavy duty makes women very noble in the eyes of Islam.

The tendency for the role of women to increase in the current context makes women more able to manage their thoughts, energy, time and all their attention to remain in their nature. The role of the breadwinner, the emancipation that is touted is not wrong, because as human beings, women also have the potential that should be explored optimally so that it is useful for the benefit of society. "The best human being is the one who benefits the most for others", this can be attributed to women who have multiple roles.

The logical consequence of this dual role is that women are required to continue to learn, and work and work so that they can become the pillars of the state that can lead their children to become golden generations in the future. So the role of women in the Islamic perspective in the contemporary context does not violate their nature as real women.

Modern women from the perspective of Islam are those who have the responsibility for their choices in life. They look great by showing Islamic morals on the one hand, but they are also
allowed to express their attitudes progressively as long as they still maintain their dignity as Muslim women. Muslim women do not have to worry about polygamy if it is necessary, be it 2, 3, or 4 women, after all, Islam also recommends that one wife is sufficient if polygamy creates a situation that causes noise and injustice.

References

[1] Al-Hadits
Visual Pawukon on Decorative Lighting

Anung B. Studyanto¹, Setyawan², Rahmanu Widayat³
{anungbs@staff.uns.ac.id¹, setyawan@staff.uns.ac.id², rahmanuwidayat@staff.uns.ac.id³}

¹ Department of Interior Design, Faculty of Arts and Design, Universitas Sebelas Maret, Indonesia
² Department of Crafts/Textile, Faculty of Arts and Design, Universitas Sebelas Maret, Indonesia
³ Department of Interior Design, Faculty of Arts and Design, Universitas Sebelas Maret, Indonesia

Abstract. The study of Pawukon figures in arts and design has become prominent, considering that these traditional arts have not attracted many followers in the academic milieu. Pawukon figures are similar to zodiacal astrology figures of Westerners. Both predictions also have beautiful pictures as symbols of the wuku characters or zodiac of human beings. Pawukon figures visually contain an aesthetic value. Visual Pawukon Exploration research for decorative lighting design development as an interior aesthetic element explores the visual Pawukon to be applied to decorative lighting designs. The research method used is qualitative in the form of action research, by creating a decorative lighting design development can be used to mark events in a new way. Implementation in Surakarta, from March to November 2020. This product to preserve traditional artworks. It is also expected to become a model for the development of decorative lighting that combines traditions and the creativity of the modern era.

Keywords: decorative lighting, design development, pawukon

1 Introduction

Pawukon is a prediction about the calculation of time found in primbon books that are owned by all circles, the general public and within the palace. [1] According Sindhunata, that pawukon form of speech implies, is used as the calculation of the good and bad days, to examine the nature of a person's character, to the profit and loss calculation.[2] Hereinafter described, to the current urban communities are not many who know pawukon, but for rural communities is estimated to still believe and use pawukon as determining the implementation of crop farming, celebration and others. In its course, Pawukon was initially only pronounced, then supplemented with text, and in the end, visual Pawukon appeared following the existing Wayang Purwo characters. Another aspect that interested both the writer and the painter remained unknown. [3] There have been many studies on Pawukon; however, very few studies on visual Pawukon development. This motive attracts researchers' attention to exploring the visual Pawukon on decorative lighting. Article Dick van der Meij 'Gods, birds, and trees Variation in Javanese pawukon illustrated manuscripts' to offer beginning to study this illustration by offering an illustrative example and connections that may exist between the maker of illustrated manuscripts.[4] The article by Rahmanu Widayat expresses interest because the characters in Pawukon have elements of wangun, visual arrangement of wangun, placement of wangun and development of Pawukon characters which are related to the concept of wangun and ora wangun [aeng]. [5] As stated by Rahmanu widayat, visual Pawukon is more comfortable for the Javanese (kejawen) to remember because it appears to
be like wayang purwa, which is close to life. Spiritually, it means that there is a counterpart between human being's works and gods. The philosophical meaning in the visual pawukon is related to Javanese's life teachings, which need to act carefully to survive, as negligence brings disaster. [5]

Pawukon, outside of belief, has a beauty value that has been passed down from the Javanese ancestors. Pawukon has been developing in Java Island for a long time. According to Prof. Dr. Philip Van Akkeren, a researcher from the Netherlands, Pawukon tracks can be traced since the 10th century, written on the charter of stone and brass or bronze with ancient Javanese letters. The charter reports the use of Javanese habitat structures in the form of a Javanese sign and Pawukon alongside India's calendar. At that time, Pawukon was already used for existing kingdoms, and even rural communities in Java had done it long before. [2]

Efforts to preserve traditional arts, in this case, Pawukon, need to be done given the meaning and role it contains. By developing decorative lighting designs, exploring visual Pawukon is expected to become a model in development and preservation. The aim of the research is to introduce Pawukon to the general public as a cultural heritage product that can function as a marker of events or dates. Next, visual exploration of visual Pawukon through decorative lighting as an effort to preserve traditional arts

2 Method

The research method used is qualitative research in the form of action research by creating the development of decorative lighting designs. The research was conducted from March to November 2020 in Surakarta, the use of digital media in the form of computers and cameras was used to support this research process. The technique of learning data is through tracing the pawukon visual library available at Primbon Pawukon, for data learning instruments through interviews and interviews of Damar Kurung lamp makers and observers in Gresik, and observing documentation of its development. The main data is in the form of 30 visual pawukon, which is then re-drawn. Its implementation used a design method through three main processes: exploration process, extraction process, and termination point process. The three stages of the design process are described in four operational steps: 1) the design analysis process and planning targets' determination, namely redrawing the appearance of the pawukon to know and understand the visual characters of the 30 wuku. 2) Design analysis process and drafting of design concepts. This is done to get the pawukon visual components and the technique of placing visual Pawukon form on decorative lights. Pawukon can provide time or date information, this is a design concept. 3) concept description process and design creation (visualization), with the application of visual pawukon to decorative lamps and the manufacture of Lampu Kurung Pawukon. By developing the design through the transformation process of visual Pawukon, it is expected that new nuances will appear and more appropriate when applied to decorative lighting.

3 Results and Discussion

The first study carried out was to redraw Pawukon figures. The Pawukon figures were processed from R.M. Soelardi's drawings who was actively involved in drawing wayang from
1930-1960 and are available in the book *Pawukon 3000*. [2] Thirty (30) *Pawukon* figures include wuku:

1. Shinta
2. Landep
3. Wukir
4. Kurantil
5. Tolu
6. Gumbreg
7. Warigalit
8. Warigagung
9. Julungwangi
10. Sungang
11. Galungan
12. Kuningan
13. Langkir
14. Mandasia
15. Julungpunjud
16. Puhang
17. Kuruwelut
18. Marakeh
19. Tambir
20. Madangkungan
21. Maktal
22. Wuye
23. Manahil
24. Prangbakat
25. Bala
26. Wugu
27. Wayang
28. Kulawu
29. Dukut
30. Watugunung

The redrawing process was conducted by tracing the outline of *Pawukon* figures. Through redrawing, the digital data of *Pawukon* figures would be obtained. The Adobe Photoshop program was utilized in the redrawing process. For each *Pawukon* figure, the standard was meticulously retrieved. The digital results of *Pawukon* figures are the principals for design development, especially in the application of the *Pawukon* figures to decorative lighting. Some of the redrawing of Visual *Pawukon* is presented below.
The second process, by analyzing the design and preparation of the design concept. Pawukon visual components are applied to decorative lamps, paying attention to the technique of placing the visual Pawukon on decorative lamps and the materials used. The Pawukon visual application was made on a wood-based pendant lamp with the printing technique on art paper. Visual Pawukon was placed in the middle of the light area, on its four sides. Two sides were drawn with Visual Pawukon, and the other two sides described Wuku. Effectiveness and efficiency become significant considerations in the use of paper materials and flexibility in exploring visual Pawukon [1].

The concept of wangun (aesthetic) is used in exploring Pawukon figures on decorative lighting, as expressed by Rahmanu Widayat, which is without changing the "inner structure." Furthermore, it is explained that the characters' visuals remain unchanged, as well as the arrangement of the composition of the characters, face to face and not back to back. [5] It is according to the researchers' efforts to redraw the visual Pawukon.

The exploration of visual Pawukon on decorative lighting is also an effort to enrich the visual Pawukon that existed before but with more various media. Based on Dick van der Meij, there are differences in the elements of the Pawukon illustration so that there is no standard in the visual depiction of Pawukon, indicating there is no rigidness. Variations indicate differences in the individual, regional, social, and temporal backgrounds of the creators. [4]

The third process is the application of visual Pawukon to decorative lamps and the manufacture of Lampu Kurung Pawukon. One of the efforts to develop decorative lighting designs with visual Pawukon exploration was inspired by Damar Kurung, developed in Gresik. Pawukon figures were applied to Lampu Kurung (cage lamp), printed in one color. It was intentionally done to see the aesthetic power of the Pawukon figures. The design and product of the lampu kurung Wuku, besides decorative lighting, can also be used as an event marker, among others; the Covid-19 pandemic, 44th UNS Anniversary 75th Indonesian Independence Day.

![Fig. 5 Waku Wukir [6]](image)

Fig. 5 Waku Wukir [6]

![Fig. 6 Redrawing of Waku Wukir](image)

Fig. 6 Redrawing of Wuku Wukir

![Fig. 7 Waku Tolu [6]](image)

Fig. 7 Waku Tolu [6]

![Fig. 8 Redrawing of Wuku Tholu](image)

Fig. 8 Redrawing of Wuku Tholu
3.1. Lampu Kurung Wuku Covid 19

Pawukon contains predictions about time calculation. When the World Health Organization (WHO) pronounced Covid-19 as the official name for Coronavirus that was first identified in China on December 31, 2019, there were exciting matters that could be attributed to Wuku in Pawukon. Judging from the date of emergence, the Covid-19 is classified as Wuku Kurantil. The depiction of Wuku Kurantil is described as follows: [7]

- Kuranthil (left) faces Batara Langsur carrying banners.
- The building collapses at the front.
- The Slindhitan bird perches on rengas tree, which shelters it often encounters trouble.

Visual Wuku Kurantil is applied to the Covid-19 cage lamp's design by complementing Cakra Manggilingan's visual. The importance of Cakra Manggilingan is about time. The changes that occur have become human nature, from day to day, month to month, and year to year. The conception of time plays an important role. The Javanese community has their calendar system. The composition of these various elements makes for an exciting, comprehensive form. Wuku Kurantil is advantageous for finding partners but not for marriage or assembling people. The prediction from Wuku Kurantil is in line with the current situation, in which the Covid-19 pandemic has affected all parts of the world. All human beings need to introspect by refraining themselves from staying at home, not doing any activities that invite crowds, and Kurantil resembles a Dhandhang bird (crow) dying of hunger and difficulty striving.

3.2. Lampu Kurung Wuku Dies Natalis UNS

Universitas Sebelas Maret Surakarta, often abbreviated as UNS, is one of the public universities located in Surakarta, Central Java. It was officially established on March 11, 1976, marked by a ceremony at the Siti Hinggil Keraton Kasunanan Surakarta. It was also marked by the Presidential Decree of the Republic of Indonesia's announcement on the opening of "Universitas Negeri Surakarta Sebelas Maret." The origin of UNS itself can be retrieved back to the 1950s. [8]
Given the establishment date of UNS, March 11, 1976, it is included in Wuku Kulawu. The name works Kulawu is taken from the son number twenty-six of Prabu Watugunung and Dewi Sinta. Raden Kulawu had a twin brother, Raden Wayang. Wuku Kulawu depiction according to Javanese primbon (horoscope) is as follows: [7]

- Batara Sadana; brave, firm stance
- The picture of Gedong at the front; abundant luck he has
- The weapon behind; an honest and straightforward character
- The tree is the Tal Tree [Palmyra Tree]; long life, strong
- The bird is a parrot.

Wuku Kulawu's characteristic is in line with the spirit of UNS. It is expected that this institution provides many benefits to the community, has achievements, is a firm stance, and can fulfill the dream to become a World Class University.

3.3. Lampu Kurung Wuku HUT RI 17 Agustus

Visual Pawukon exploration was also applied to the commemoration of the Indonesian Independence Day in a residential area. On the four sides of the cage lamp of the Indonesian Independence Day, there was a visual exploration of Wuku Manahil [August 17, 1945], UNS Logo, Wuku, and the 75th Year Indonesian Independence Logo.

Wuku Manahil takes after the name of son number twenty-one of Prabu Watugunung and Dewi Sinta. Raden Manahil had a twin, Raden Prangbakat. Those who take after wuku Manahil will generally have a character described as follows. The characters and attitude of Wuku Manahil, according to the Javanese primbon, are as follows [7]:

- Batara Citragotra; easy to mingle, cautious, and sharp-minded
- Tigaron tree or wood; firm stance
- Sepahan (minivet) bird; quick-witted and small eater
- The disaster of getting stabbed by a sharp weapon

Given the characters of Wuku Manahil, it is according to Indonesia's conditions during independence, as a nation that had long been struggling to become an independent, strong nation, in a time full of concern.

Wuku Warigalit takes after the name of son number five of Prabu Watugunung and Dewi Sinta. However, according to the gestational age of Dewi Sinta, Warigalit was born from the
third pregnancy. Of 27 sons of Dewi Sinta, 13 were born twins, while the 14th pregnancy was a singleton. During her first pregnancy, Dewi Sinta gave birth to twins, Raden Wukir and Raden Kurantil. In her second pregnancy, Raden Tolu and Raden Gumbreg were born. Meanwhile, during the third pregnancy, Raden Warigalit and Warigagung were born. Wuku Warigalit descriptions are as follows: [7]

- Warigalit (left) faces Batara Asmara
- Kapodang (black-naped oriole) birds fly over the sulastri (soulattri) tree, and they do not like to mingle with others.
- The temple at the front; pleased to meditate and easily concerned
- Sulastri (soulattri) tree or wood; beautiful, adored by many people

The characters of Wuku Warigalit appear to share similarities with the current condition during the Covid-19 Pandemic. Human beings on earth in general and Indonesia, in particular, require a lot of attention and prayer.

Fig. 15 Redrawing of Wuku Warigalit

Fig. 16 Redrawing of Wuku Manahil

Fig. 17, 18, 19 The Visual Application of Wuku Warigalit, wuku Manahil, 75th Indonesian Independence Day Logo and UNS Logo on Decorative lighting [Lampu Kurung Wuku Indonesian Independence Day]

4 Conclusions

Visual Pawukon on decorative lighting as a calendar can be used to mark events in a new way. Decorative lighting with visual Pawukon is an effective medium for preserving traditional arts and has the potential as a creative product variant that can be developed further.
There is an opportunity for further exploration in the development of decorative lighting designs with the application of visual Pawukon, considering that there are many decorative lighting design developments that have not been conducted.

Suggestions
The development of decorative lighting with the application of visual Pawukon has an opportunity to introduce visual Pawukon to the general public. The potential to raise Lampu Kurung Wuku as a traditional art product for the Solo community, given that decorative lighting that has developed in several cities in Indonesia is a work of old traditions and needs to be preserved. Cities in Java Island such as Gresik, Kebumen, Semarang, Bali, and Solo have traditional decorative lightings, such as lanterns or cage lamps.

References
Development of Powerpoint-Based Multimedia for Elementary School Teachers

Azizah Hayati\textsuperscript{1}, Ristiana Dyah Purwandari\textsuperscript{2}
\{azizahhayati.mai@gmail.com\textsuperscript{1}, ristianadyah@yahoo.com\textsuperscript{2}\}

Elementary School 2 Bojanegara\textsuperscript{1}, Elementary School Teacher Study Program, Universitas Muhammadiyah Purwokerto\textsuperscript{2}

Abstract. This article discusses the creativity of teachers in making thematic science teaching materials. This article aims to know that teacher creativity can be developed through training so that teachers can create thematic science teaching materials. This research aims to develop teachers' creativity in creating science thematic teaching materials through training through the Microsoft PowerPoint app. The method of writing this scientific work is to use Research and Development (RnD). Creativity consists of two dimensions, namely cognitive (creative thinking), affective (creative attitude). Creative thinking includes fluency, flexibility, originality, elaboration, and evaluation. Creative attitudes include openness, flexibility in attitude, freedom in self-expression, appreciating fantasy, interest in creative activities, belief in ideas themselves, self-reliance in giving consideration. While creative (psychomotor) skills include determining creative challenges, identifying information sources, developing and selecting ideas, presenting product results, and authenticity. Related to the creativity of teachers, teachers are expected to make thematic materials of science. Science thematic teaching materials are all forms of materials used to assist teachers or instructors in carrying out teaching and learning activities in the classroom in the form of written or unwritten materials that focus on science learning to grow students' abilities in an incanity and contains any way according to real life. Developing teacher creativity training can train teachers in making science thematic teaching materials that benefit teachers and appeal to students.

Keywords: Creativity, Teacher, Teaching Materials, Science Thematic, Training

1 Introduction

The development of human life, the development of problems faced by education, increasingly demands human progress in thinking about education. Now it is increasingly realized that education plays an essential role in the life and progress of humanity. \cite{2}Education is a human effort to build his personality following the values in society and culture. One of the roles of a teacher with competence that he has, is the transfer of knowledge and agent of change. A teacher must always be responsive to the situation, responsive to the latest news and discourses. Teachers should also make teaching materials and know the applications that support in carrying out teaching and learning activities.

Based on observations and interviews, this situation becomes a problem for teachers at SDN 2 Bojanegara. Some teachers are not ready to conduct modern learning and are always related to information and communication technology, one of the educational progress conditions. Especially during the Covid19, teachers find it challenging to provide learning because they cannot come face-to-face with students directly.
Teachers’ ability to master technology seems to be challenged when students and teachers are no longer able to meet face to face. Teachers should also be able to satisfy parents as customers of educational services. Therefore, it is necessary to develop teacher professionalism to be sustainable to maintain and improve teacher creativity, including activities designed to improve teacher skills, understanding and skills with the help of advanced technology with applications that are developing today, applications used are available in each laptop or computer and handphone so that teachers can make creative teaching materials.

Creating and editing software selection for teachers in Simo, P., Fernandez, V., et al. (2010), to achieve a minimum degree of autonomy in elaborating dynamic teaching materials themselves, is part of ongoing training and is, therefore, a key element in improving self-teaching. So videos that are added written explanations related to audiovisual content are excellent teaching materials, as they provide a clear and complete picture of a particular event or process. Creating short, low-cost educational videos allows re-use in other pieces of training and creating your videos made.

Based on the above problems and considerations, research is needed to develop teacher creativity in teaching materials. It is accommodated in educational and training activities for teachers entitled "Developing teacher creativity training in making science thematic teaching materials through Microsoft PowerPoint application in Elemetary School." The development of this creativity training will consist of a program design in training for elementary school teachers with more emphasis. Elementaryers’ creativity in making teaching materials with the help of technology/application that develops, teaching materials that will be made in the form of learning videos.

2 Method

The research method used is research development, namely Research and Development (RnD), with its development in the form of training programs to make thematic teaching materials of science to develop elementary school teachers’ creativity. The development model used refers to the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model developed by Robert Maribe Branch. Addie model is one of the systematic learning design models with steps used more simply, clearly, and has been widely used in previous research. This model consists of five steps, namely: analyze, design, development, implementation, and evaluation. The steps of the ADDIE model can be seen in the following figure:
Fig 1. Development Measures according to Dick and Carry model ADDIE

The development procedure in this research uses the ADDIE model stage developed by Robert Maribe Branch. The ADDIE model was developed to design a systematic, simple, and transparent learning system. Development steps as follows (Sugiyono, 2016: 38-39):

- **Analyze** is related to the analysis of the working environment situation to find what development will be done.

- **Design** is the stage of designing activities to be carried out. The design is still conceptual and will underpin the next development process. The design stage is focused on three activities: material selection following the demands of creative competencies to be achieved, development strategies, forms, and assessment and evaluation methods.

- **Development** is at the stage of development carried out several activities: searching and gathering various relevant sources to enrich materials, making teaching materials, training on teachers, charts and graphics needed, typing, editing, and storage in the form of learning videos. The following activities in the development stage are activities to validate the draft product development and revision after experts' input.

- **Implementation** is the activity of using products. At this stage, the development results are applied to improve teacher creativity in making thematic teaching materials of science.

- **Evaluation** is an activity to assess whether each step of activities and products that have been made is following the specifications or not. The evaluation results are used to provide feedback to the user, and revisions are made following the evaluation results or needs that have not been met in developing the teacher's creativity.

A research site is a research place for researchers at SDN 2 Bojanegara, Padamara Subdistrict, Purbalingga Regency. The research subjects involved teachers at SDN 2 Bojanegara, grade 1 teachers, grade II teachers, grade III teachers, two grade 4 teachers, two grade V teachers, grade 6 teachers, Islamic Religious Education teachers, and Sports Physical Education teachers of 1 person each.
1. Teachers at SDN 2 Bojanegara, filling out questionnaires and initial interviews involving teachers at SDN 2 Bojanegara. Teachers at SDN 2 Bojanegara filled out questionnaires and interview guidelines.

2. Measurement of teacher creativity is done in science thematic teaching materials training through Microsoft PowerPoint application. The subjects of the next phase of the study included the validator, principal of SDN 2 Bojanegara.

The research instruments used are questionnaires, interviews, observation guidelines, Measurement sheet of teacher's creative thinking skills, measurement sheet of teacher's creative attitude. The teacher's creative thinking skills sheet was adapted from Purwandari (2018), and the teacher's creative attitude measurement sheet was adapted from the Creativity Attitude Survey by Carles E. Schaefer, Ph.D., Fordham University (Munandar, 1999).

Assessment of teachers' creative thinking skills by validators using this type of Likert scale. This Likert scale is arranged in the form of a statement and followed by four responses that will indicate the level, which includes:

Tabulation of all data obtained for each aspect of the assessment item available in the assessment instrument. Calculate the average total score of each aspect by using the Sudjana formula (2009: 109)

\[ \bar{X} = \frac{1}{n} \sum_{i} X_i \]

\[ \bar{X} \] = Average value  
\[ \sum_{i} X_i \] = Sum of values obtained.
\[ n \] = number of statement items

The preparation of scoring guidelines is with the number of items 20 statements, using four scales, then the maximum score of 80 and a score of at least 20. The calculation formula of the range is as follows:

Scale range = \( \frac{\text{highest score} - \text{lowest score}}{\text{number of interval classes}} \)

Converts the average score of each aspect obtained into qualitative based on four scale assessment criteria. For conversion, the practicality assessment score is obtained by calculating the interval from 1 to 4, which is 0.75. After that, the score obtained in the conversion into qualitative data as in Table 1.

| Table 1. Conversion of Quantitative Data Score into Qualitative Data |
|-----------------------------|-----------------------------|
| **Average** | **Criteria** |
| 1,00 < \( X \) < 1.75 | Less Creative Thinking |
| 1.75 < \( X \) < 2.50 | Enough Creative Thinking |
| 2.50 < \( X \) < 3.25 | Good Creative Thinking |
| 3.25 < \( X \) < 4.00 | Very Well Creative Thinking |

Source: Sudjana (2009: 109) modified researcher

Teacher Creative Attitude Analysis, assessment of teacher's creative attitude by validator using Likert scale type. This Likert scale is arranged in the form of a statement and followed by four responses that will indicate the level, which includes:
Tabulation of all data obtained for each aspect of the assessment item available in the assessment instrument. Calculate the average total score of each aspect by using the Sudjana formula (2009: 109) using formula (1). The preparation of scoring guidelines is with the number of items 20 statements, using four scales, then the maximum score of 80 and a score of at least 20. The calculation formula of the range is as follows:

\[
\text{Scale range} = \frac{\text{highest score} - \text{lowest score}}{\text{number of interval classes}}
\]

Converts the average score of each aspect obtained into qualitative based on four scale assessment criteria. For conversion, the practicality assessment score is obtained by calculating the interval from 1 to 4, which is 0.75. After that, the score obtained in the conversion into qualitative data as in Table 2.

<table>
<thead>
<tr>
<th>Average</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00 &lt; X &lt; 1.75</td>
<td>Less Creative Attitude</td>
</tr>
<tr>
<td>1.75 &lt; X &lt; 2.50</td>
<td>Enough Creative Attitude</td>
</tr>
<tr>
<td>2.50 &lt; X &lt; 3.25</td>
<td>Good Creative Attitude</td>
</tr>
<tr>
<td>3.25 &lt; X &lt; 4.00</td>
<td>Very Well Creative Attitude</td>
</tr>
</tbody>
</table>

Source: Sudjana (2009: 109) modified researcher

3 Results and Discussion

This research is a Research and Development (RnD) research with its development in training programs to make thematic teaching materials of science to develop the creativity of elementary school teachers. The development model used refers to the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model developed by Robert Maribe Branch. The stages carried out in the training program make thematic teaching materials of science to develop the creativity of elementary school teachers. The first stage is the analysis stage (Analyze) is carried out a procedure used to foster teacher creativity. Based on the analysis of needs obtained through observation, the result is that creative thinking, creative attitudes, and teachers' creative skills have not been fully supportive of teaching materials. Therefore, the first stage of analysis is carried out in training by displaying examples of teaching materials in interesting learning videos for teachers to make.

The design stage is carried out the preparation of teaching materials that produce drafts, teachers draft drafting teaching materials according to the video of learning that has been displayed and teaching materials. The draft is tailored to the classes that each teacher has mastered or according to their respective fields of study. The development stage is carried out by mentoring to make teaching materials in learning videos carried out by researchers. Teachers are guided to create learning videos through the Microsoft PowerPoint app. Steps taken 1) introduction of Microsoft PowerPoint applications and tools and features contained in PowerPoint, 2) steps to create teaching materials using engaging powerpoints, such as (a) selection of exciting templates that can be obtained by downloading for free on google (b) how to crop learning materials from the teacher's book (c) utilization of shapes, colors, animations, and design features, and (d) inserting images/videos (e) hyperlinks, 3) Utilization of notes on PowerPoint to assist in the process of recording audio, 4) the process of recording audio (dubbing sound) and 5) the process of converting PowerPoint media into learning videos. In
addition to material exposure and direct practice, this stage is also followed by question and answer sessions and discussions to find out the level of understanding of participants in this activity.

There are steps in making teaching materials in the form of learning videos as follows:
1. They were preparing teaching materials or teaching materials that are already available in the BSE Teacher's Book. All trainees must prepare teaching materials referring to the RPP already owned by the participants. And in this exercise, participants were asked to complete learning materials for one meeting as a suitable material.
2. Design background teaching materials in Microsoft PowerPoint to make them more attractive. After the participants crop the material and then insert it into the slides until it is finished, the participant is directed to include images and videos that are interesting and relevant to the material's theme to be used as the background or background of the material. This aims to make the display of teaching materials more enjoyable to be read by the learners.
3. Utilization of notes on PowerPoint to assist in the audio recording process
   Step three, the teacher/participant writes what will be delivered in the learning video, for example
   Narrative:
   1) Say hello
   2) Remind pray before learning
   3) This time with me ..... We'll learn about.....
4. Audio recording process (dubbing sound)
   Step four, audio recording should be in a quiet place or use a mic for mobile phones that are now widely traded—Proses merubah media PowerPoint menjadi video pembelajaran.
5. The fifth step is to convert the typed and designed material in ppt format into mp4 form.

Implementation stage, to find out the improvement of teacher creativity in making thematic teaching materials of science. Based on the questionnaire/questionnaire of teachers' creative thinking skills and the trial implementation results, I obtained an average of 2.42 included in the criteria enough. In the implementation of trial I, the average teacher has not added various materials to the teaching materials, has not given new ideas in making teaching materials, only following the directions given, just following the idea that has been given. At the same time, the questionnaire/questionnaire test of the teacher's creative attitude, the results of the first trial's implementation obtained the average creative attitude of teachers 3.1 with the right criteria because the teacher has been able to make his teaching materials still feel hesitant. The teacher has a desire to make teaching materials that are useful for learners. During the training, the teacher was enthusiastic about making ajat material because he wanted to get better learning ideas than before.

After the first trial, the teacher was guided again in teaching materials in learning videos that are more following the teaching materials and specifications of teacher creativity more complete than before with trial II. After the evaluation stage is completed, training/training teacher creativity can be resumed on a wide scale. Analysis of teachers' creative thinking skills in creating science thematic teaching materials through Microsoft PowerPoint applications on the development of teacher creativity training. In creative thinking skills, teachers' activities are based on questionnaires/questionnaires that have been distributed to teachers or trainees. This observation and research activity concerns teacher creativity training development in the first and second trial stages. The tables and histograms on teachers' creative thinking skills are as follows:
Table 3. Observation Results of Teacher's Creative Thinking Skills

<table>
<thead>
<tr>
<th>Trial</th>
<th>Average Trial</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>2.42</td>
<td>Enough Creative Thinking</td>
</tr>
<tr>
<td>II</td>
<td>3.14</td>
<td>Good Creative Thinking</td>
</tr>
<tr>
<td>Increased</td>
<td>0.72</td>
<td></td>
</tr>
</tbody>
</table>

Based on Table 3 and Fig 1 above, the teacher's creative thinking skills improved on average on each trial I trial II indicator. Teacher creativity development training during the first trial has enough criteria. This result is known with a total score of 206, with an average of 2.42. According to the results in this I trial, it turns out that the teacher's creative thinking skills are still included in the criteria enough. This can be seen from the teacher still making teaching materials that are following the example researchers. Teachers still have difficulty in making teaching materials in the form of interactive videos. In the second trial, the teacher made impressive teaching materials following the ideas/teaching materials. The observation of teachers' creative thinking skills in the second trial had the right criteria. This result was known with a total score of 267, with an average of 3.14. Therefore, teacher creativity development training succeeds in improving teachers' creative thinking skills in making teaching materials.

The creative thinking skills of teachers in the first trial to trial II have increased with the results of teaching materials that teachers have made in the form of learning videos that teachers have been able to determine teaching materials made based on teaching materials, teachers have also been able to add a variety of materials to the teaching materials in the form of videos made by themselves based on the results of work with learners not only the results of videos from youtube, teachers are also able to add questions/exercises/practices to the teaching materials not only material, teachers in making teaching materials not only focus on what has been learned in training but able to develop themselves according to their thoughts and the teacher not only follow the idea that has been given, designed with his ideas without interference with others.

Analyze the impact of teachers' creative attitudes in creating science thematic teaching materials through Microsoft PowerPoint applications on teacher creativity training development. In the study of teachers' creative attitudes based on questionnaires that have been distributed to teachers or trainees. This observation and research activity concerns teacher creativity training development in the first and second trial stages. The tables and histograms on the teacher's creative attitude are as follows:
Table 4. Observations of Teachers’ Creative Attitudes

<table>
<thead>
<tr>
<th>Trial</th>
<th>Average Trial</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>3.1</td>
<td>Good Creative Attitude</td>
</tr>
<tr>
<td>II</td>
<td>3.54</td>
<td>Very Well Creative Attitude</td>
</tr>
<tr>
<td>Increased</td>
<td>0.44</td>
<td></td>
</tr>
</tbody>
</table>

Fig 1. Histogram Of Teacher's Creative Attitude

In table 4.2 and figure 4.4 as above, the teacher's creative attitude has improved. In the trial, I obtained an average of 3.1 with suitable criteria. In the trial, II obtained an average of 3.54 with excellent criteria. The overall average increase from trial I and trial II was 0.44, so it can be concluded that the teacher's creative attitude has been successful. The teacher's creative attitude has improved in the first trial. Trial II is seen with the teacher's attitude in making teaching materials in the form of exciting learning videos by being able to bring out a positive openness attitude with new experiences. The new experience here is training in teaching materials for teachers, responding well to the attitudes that have been given before and after the training is carried out, teachers can make teaching materials that are fun for learners, utilizing fantasies that are out of mind so that the teaching materials are made interesting, utilizing the creative activities that appear in the learning video, bringing up his ideas instead of the ideas of others, and self-reliance in making his teaching materials.

Analyze teacher responses to teacher creativity development programs in creating science thematic teaching materials using Microsoft PowerPoint applications. This study obtained results based on questionnaires and interviews before teachers/trainees' training that the learning conducted during the Covid-19 pandemic was carried out by online and offline learning. Still, because of the increasing cases, 75% of learning was carried out by online methods, tasks given to students through Whatsapp, google form, and Student Worksheets (LKPD), the form of ringing materials that support learn vital text, PPT, video learning. Teachers gain knowledge on the design of teaching materials other than lectures and training, obtained from KKG and Webinars. Teachers are still less able to make their own teaching materials, steps to meet the needs of teaching materials most teachers are looking for information. All teachers at SDN 2 Bojanegara want to make their own teaching materials because they are important to support learning and all of them are supported by teaching materials provided by the school in accordance with the students' learning needs. Through training in teaching materials through the Microsoft PowerPoint application, teachers will apply it after the training is ced out so that
students can understand the material. After the training, the teacher will create materials that are developed according to competencies.

The training was conducted based on questionnaires and interviews. Essential felt the impact of the training on making teaching materials followings learn at home even if they did not come face-to-face with the teacher. Teachers are happy to attend training and do not feel time-consuming. Training materials need to be supplemented with other training, and the materials delivered are excellent and useful for teachers. This training can be held in other schools, not only at SDN 2 Bojanegara. The factors that support this training activity are the cooperation of all teachers to make their teaching materials. After participating in the training, teachers have made their impressive teaching materials so that learning during the Covid-19 pandemic does not run into obstacles because of all teachers' spirit at SDN 2 Bojanegara.

1. Results of Improving Teacher Creativity During Training

   Based on the results of questionnaires distributed to teachers/participants to find out how many participants experienced "increased creativity in making teaching materials," then in figure 4.5 showed there was a 100% increase in "Creative Thinking Skills," 75% increase in "Creative Attitudes" and 91% increase in "The role of training in making teaching materials."

![Improving Teacher Creativity](image)

2. Material Results During Training

   Based on the results of questionnaires distributed to teachers/participants to find out how many participants feel complete, complete, or incomplete about "teaching materials in the implementation of training/training," then in figure 4.6 shows 8 participants, 100% feel complete about the material "creative attitude," there are 83% feel complete about the material "role of training in making teaching materials" there are 75% feel complete about the material "Creative Thinking Skills."
In line with the research results of Septia Wahyuni et al. (2020) with the title "Training on Creating Interactive Learning Media using PowerPoint." Learning video creation training activities using PowerPoint media were successfully carried out. The desired target in this training activity is achieved. It can be seen from the results of the questionnaire processing given to the trainees at the end of the meeting, showing that 89% of the trainees were interested in the training provided. Participants gained new knowledge related to learning media that can be used in delivering materials to students. Even participants asked for other pieces of training to help them gain knowledge about other interactive learning media.

Analysis of teacher creativity development training's advantages and limitations in creating science thematic teaching materials through Microsoft PowerPoint applications. Based on responses, responses, and teachers' participation, the advantages of training in developing teacher creativity in making science thematic teaching materials through Microsoft PowerPoint application are the materials obtained in the training according to their needs. The application used is easy to use by teachers. Increase teacher motivation to increase creativity in presenting learning materials online. The training theme is following teachers' needs during the Covid-19 pandemic who need training in making teaching materials. The stylist clearly and intrigued by the training material. Fill the teaching materials according to the ability that is supplied to the teacher.

Limitations on training in developing teacher creativity in making science thematic teaching materials through Microsoft PowerPoint appin training the time given for this training is less long, and some teachers suggest a longer training time so that the material given is more detailed and they have the opportunity to practice it and ask if there are difficulties. This is also supported by the research results conducted by Suana et al. (2018) with the title "Pengembangan Perangkat Flipped Classroom," which states that practical learning tools will make it easier for teachers to manage the classroom appropriately. Thus, the activity of making teaching materials in the form of electronic video can be useful for teachers who need it because it can be accessed online as said by Faruq et al. (2017) with the title "Pengembangan Media Pembelajaran Interaktif Online Pokok Bahasan Barisan Aritmetika Berbantuan Microsoft Visual Basic Fathulloh. From the data exposure above, it can be concluded that teachers' creativity in making teaching materials in the form of learning videos supports the learning process from aspects of creative thinking skills and creative attitudes. Helped by the development training, teacher creativity experienced a significant increase in creativity, making thematic teaching materials of science.
4 Conclusion

From the results of the analysis that has been done by researchers, this study can be concluded that the creative thinking skills of teachers at SDN 2 Bojanegara fall into a suitable category. This is evidenced based on questionnaires given to 8 respondents, namely participants/teachers who participated in the training from the trial I to trial II experienced an increase in. During the first trial, teacher creativity development training has enough criteria; this result is known with a total score of 206 with an average of 2.42. The observation of teachers’ creative thinking skills in the second trial had the right criteria; this result was known with a total score of 267 with an average of 3.14. Therefore, teacher creativity development training succeeds in improving teachers’ creative thinking skills in making teaching materials.

The creative attitude of teachers at SDN 2 Bojanegara is a good category. This is proven based on the trial. I obtained an average of 3.1 with suitable criteria. In the trial, II obtained an average of 3.54 with excellent criteria. The overall average increase from the trial I and trial II was 0.44, so it can be concluded that the teacher creativity development training succeeded in improving teachers’ creative attitude in making teaching materials.

So that by implementing training in the development of teacher creativity, there is a transfer of knowledge about understanding and ability in making teaching materials. So that Microsoft PowerPoint applications can help create teaching materials during online learning during this pandemic and learning activities can run well. With hands-on practice and creativity, the results of teaching materials show that teachers are increasingly skilled in making, designing teaching materials in interactive videos that can be used online.

Based on the research conducted at SDN 2 Bojanegara, the researchers submitted several suggestions, among others for all parties, especially the stakeholders, it is expected to pay more attention to teachers’ creativity in each school. Because with the low creativity of teachers, fast or lamp at the next generation of the nation will be left behind with other nations. For teachers to always develop creative teaching materials to be used in the teaching and learning process. Educational institutions or other institutions should conduct training to increase the creativity of teachers in making teaching materials.

References


The Effects of Instructional Leadership and Organizational Culture on Teacher Performance at Public Senior High Schools in Sleman Regency, Indonesia

Banu Widiasmara¹, Dwi Esti Andriani²
{bwidiasmara@gmail.com¹, dwi_esti@uny.ac.id²}

Educational Management Study Program, Graduate School, Universitas Negeri Yogyakarta, Indonesia¹, Educational Management Study Program, Graduate School, Universitas Negeri Yogyakarta, Indonesia²

Abstract. This study aims to examine whether principal instructional leadership and organizational culture have effects on teacher performance separately and simultaneously. This ex-post facto quantitative research was conducted at several public senior high schools located in Sleman regency, Indonesia. The sample of this study was collected from 244 teachers who were selected using a proportionate random sampling technique. A valid and reliable questionnaire was developed to collect the data which were then analyzed quantitatively using the SPSS version 20. The results show that instructional leadership of the principals and organizational culture significantly influence teacher performance separately and simultaneously.

Keywords: Instructional Leadership, Organizational Culture, Teacher Performance.

1 Introduction

High quality of education requires teachers with high performance. They are teachers who are always motivated to improve their ability to plan, implement, and assess learning [1]. The level of teacher performance is influenced by many factors [2]–[4]. Two of them are principal instructional leadership and organizational culture.

Instructional leadership involves activities carried out by a school principal to improve the quality of learning processes and student learning achievement [5]–[7]. This leadership affects student achievement indirectly and is mediated by the teachers [8]. A study conducted by Sukmawati and Herawan in Indonesia shows that there is a positive and significant influence (64%) of principal instructional leadership on teacher performance [9].

Organizational culture also has a significant effect on teacher performance [10]. The culture is a repetitive habit that serves as the value and lifestyle of people within an organization [10]–[12]. Organizational culture will influence the behavior of organization members leading to the achievement of organization goals [3]. Pastin states that it is definite that a strong culture underlies people's beliefs, behaviors, and ways of doing things because culture and tradition are closely correlated [13].

Performance is the outcome of physical and non-physical work [14]. Performance is the result of work achieved by employees as they complete assigned tasks and fulfill responsibilities...
Khine et al. in Yuliejatningsih argue that teacher performance is a means of carrying out the teacher's main task which is teaching [16]. In line with it, teacher performance is the ability to plan, implement, and assess learning both related to its process and results [1]. Planning lessons includes activities to formulate what will be done to facilitate student learning activities, how to do it, and what students will achieve [1]. The result is the lesson plan. It presents the procedures and organization of learning to achieve competencies that are defined in the national standard of content and syllabus [2].

Implementation of learning begins with attracting student attention and providing stimulus to prepare the students mentally [1]. When learning takes place, teachers are required to be creative so that students learn according to the plan prepared. Teachers should be able to decide whether teaching and learning activities should be terminated, or the teaching method should be changed. They also need to be aware of the needs to repeat the explanation of previous lessons when students do not achieve the learning objectives set. In addition, teachers should obviously master the lesson materials [17].

Before ending a lesson, teachers should conduct an evaluation as well as provide feedback and reinforcement. Evaluation of learning outcomes is carried out to determine the level of student understanding and ability. It finds out how well the material is delivered and whether the students have mastered the materials presented. Accordingly, the results can be used to improve the quality of learning [1].

Leadership is the act of influencing others to achieve expected goals [18]–[20]. Leadership is also defined as a social process to achieve common goals in groups [21]. In line with it, leadership is a social process in which an individual or group influences other people's behaviors to achieve common goals [22].

Instructional leadership is one of the principal leadership models. This model is believed to be effective in improving student learning achievement [8]. It provides indirect effects, mediated by the teachers. Research shows that instructional leadership has a significant effect on teacher performance [9]. The most popular model of instructional leadership is developed by Hallinger and Murphy. This model suggests three dimensions of leadership behavior, namely: defining the school mission, managing the instructional program, and developing the school learning climate [23].

This dimension refers to the role of principals in allocating certain resources in some periods of time, for example in one academic year. School principals as the instructional leaders ensure that schools have clear, measurable, and achievable goals by focusing on the student academic progress and communicating the goals to school teachers, administrative staff, and students [24].

This aspect refers to the principal's role in coordinating and controlling curriculum and learning [25]–[27]. This role requires the principal to make formal and informal class visits and provide feedback on teaching practices. When supervising and evaluating teaching, the principal ensures that learning leads to the goals determined [28]–[30].

The third element refers to the role of the principal in creating a conducive situation for teachers and students to be productive in learning and improving school quality [31]. Principals should organize student learning hours, develop teacher professionalism, provide high visibility, and give rewards to teachers and students for their achievements [24].

Organizational culture is a set of shared assumptions of people in an organization. This culture determines how organizational members perceive, think, and react to their environment. It also reflects the values and norms that serve as the vision and mission of the organization in order to achieve its goals. It is further explained that organizational culture can give members an organizational identity, facilitate collective commitment, create social system stability, and shape behavior by helping its members understand their surroundings [32].
Organizational culture provides cultural forms such as symbols, languages, narratives, and activities that highlight values and norms that somehow improve the members' sense of belonging to the organization and help give meaning to the organization activities [33]. Organizational culture, therefore, can help organizations maintain the performance of organizational members which in turn will support organizational performance [34]. Many experts suggest dimensions of organizational culture that can be used as an assessment instrument. Four dimensions of organizational culture that have been widely used, namely involvement, consistency, adaptation, and mission [35].

Involvement is a treatment that makes staff feel involved in the decision-making process so that they have a sense of responsibility for what is done [35], [36]. Involvement consists of three main indicators, namely empowerment, team orientation, and capability development [37]. Consistency is the agreement among organizational members on the basic assumptions and core values of the organization [13], [36]. Consistency is measured from the staff commitment to the organization. It is also related to what to do and what not to do. Consistency is a dimension that maintains the strength and stability of the organization [35], [37]. Adaptability is an organization's ability to transform environmental influences on the organization by making organizational internal changes [36]. The changes allow the organization to develop and grow. The ability to adapt can be measured by three indicators, namely creating change, customer focus, and organizational learning [35]. Mission is a cultural dimension that shows the main goals of the organization. A mission makes organization members more united and focused on what the organization considers important [36]. If an organization's mission is weak, staff will have no clue of short-term and long-term goals to be achieved [37]. Three indicators of good missions are well defined and clear strategies, goals, and visions.

2 Method

2.1 Research Design and Setting

This is a quantitative study that approaches phenomena objectively and then analyze them quantitatively [38]. It employed the ex post facto design that examined the correlation between programs and existing activities without manipulation or treatment.

2.2 Research Population and sample

This study was conducted in 17 public senior high schools located in Sleman Regency. The data were collected in three months, from June to August 2020. The participants of this study were 626 teachers with various educational backgrounds, positions, and ranks. The sample was selected using the proportionate random sampling technique. The sample was calculated using the following formula.

\[ n = \frac{N}{1 + Ne^2} \]  

Information:
- \( n \) = Size of sample/number of respondents
- \( N \) = Size of population
- \( e \) = error rate of 5%

Applying the formula above, the total number of the sample from the studied schools is:
\[
\begin{align*}
n &= \frac{626}{1 + 626(0.05)^2} \\
&= \frac{626}{1 + 626 \times 0.0025} \\
&= \frac{626}{2.565} = 244
\end{align*}
\]

Then, each school sample size was calculated using the Proportionate Random Sampling formula below:

\[
N = \frac{x}{S} \times n \tag{1}
\]

**Description**

- **N**: Number of samples of each school
- **x**: Number of samples of each school
- **S**: Total population of all schools
- **n**: Sample size/total respondents

Using the above formula, the total sample of each school is presented in the table below.

**Table 1. Research Sample Data**

<table>
<thead>
<tr>
<th>No</th>
<th>School name</th>
<th>Total number of teachers</th>
<th>calculation</th>
<th>Number of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SMAN 1 DEPOK</td>
<td>42</td>
<td>(\frac{42}{626} \times 244)</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>SMAN 1 MLATI</td>
<td>35</td>
<td>(\frac{35}{626} \times 244)</td>
<td>14</td>
</tr>
<tr>
<td>3</td>
<td>SMAN 1 NGAGLIK</td>
<td>44</td>
<td>(\frac{44}{626} \times 244)</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>SMAN 2 NGAGLIK</td>
<td>45</td>
<td>(\frac{45}{626} \times 244)</td>
<td>18</td>
</tr>
<tr>
<td>5</td>
<td>SMAN 1 GAMPING</td>
<td>28</td>
<td>(\frac{28}{626} \times 244)</td>
<td>9</td>
</tr>
<tr>
<td>6</td>
<td>SMAN 1 KALASAN</td>
<td>51</td>
<td>(\frac{51}{626} \times 244)</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>SMAN 1 SLEMAN</td>
<td>47</td>
<td>(\frac{47}{626} \times 244)</td>
<td>18</td>
</tr>
<tr>
<td>8</td>
<td>SMAN 2 SLEMAN</td>
<td>31</td>
<td>(\frac{33}{626} \times 244)</td>
<td>13</td>
</tr>
<tr>
<td>9</td>
<td>SMAN 1 PRAMBANAN</td>
<td>46</td>
<td>(\frac{46}{626} \times 244)</td>
<td>18</td>
</tr>
</tbody>
</table>
2.3 Operational Variable Definition

Instructional leadership refers to principal behaviors to improve the quality of learning processes and student learning achievement as measured from three dimensions, namely defining the school mission, managing the instructional program, and developing the school learning climate to improve the quality of student learning processes and outcomes. Organizational culture refers to a combination of values, norms, beliefs, and expectations that are used as guidelines by people within an organization. This point includes the dimensions of involvement, consistency, adaptability, and mission. Teacher performance refers to the ability to complete their main tasks and responsibilities, namely planning, implementing, and assessing learning.

2.4 Research instrument

The instrument used in this study was a closed-ended questionnaire. The questionnaire validity and reliability were empirically measured before the questionnaires were distributed to 30 randomly selected teachers from several public senior high schools in Sleman Regency. The instrument validity was measured using the product-moment correlation formula. The validity test results show that all values $r_{count} > r_{table}$. This means that all items on the instructional leadership variable, organizational culture, and teacher performance were valid. Alpha Cronbach formula was used to measure the instrument reliability. Then, based on the calculation, it was found that the instrument was reliable. The result of the reliability test is presented in Table 2 below.
### 2.5 Data analysis technique

This study employed the simple regression and multiple regression data analysis techniques. Simple regression technique is based on the functional or causal relationship of one independent variable with another dependent variable in which its coefficient of determination is tried to be found \((R^2)\) [39], [40]. The value \((R^2)\) was determined by the square of the r value. The results \((R^2)\) were then multiplied by 100% to determine the amount of the contribution of the influence of the dependent variable to the independent [39].

Hypothesis testing was conducted using the multiple regression analysis technique and determination coefficient through several stages. Firstly, the regression line equation was determined Secondly, the \(a_1\) (predictor coefficient of \(X_1\)) value was calculated using this formula \(\sum x_1y = a_1\sum x_1^2 + a_2\sum x_1x_1\), and the value of \(a_2\) (predictor coefficient of \(X_2\)) was calculated using this formula \(\sum x_2y = a_1\sum x_2 + a_2\sum x_2^2\). At last, the determinant coefficient \((R^2)\) of the \((R)\) square correlation between \(Y\) and \(X_1, X_2\) was calculated using the formula below.

\[
R_{y(1,2)} = \sqrt{\frac{a_1\sum x_1y + a_2\sum x_2y}{\sum y^2}}
\]

The last step was determining the significance using the F test below.

\[
F_{reg} = \frac{R^2(n - m - 1)}{m(1 - R^2)}
\]

If the value of \(F_{reg}\) (\(F_{count}\)) is higher than \(F_{tables}\), there is a significant effect of the independent variable on the dependent variable.

### 2.6 Prerequisite Test Analysis

#### 2.6.1 Normality test

The normality test was done to ensure that the data were normally distributed. The analysis in this study employed the Kolmogrov-Smirnov K-S test. If the probability value is higher than 0.05, the population distribution is normal, and if the probability is lower than 0.05, the population is not normally distributed [41]. The results of the normality test are presented in Table 4 below.

### Table 4. Normality Test Results

<table>
<thead>
<tr>
<th>Principal's Instructional Leadership Variables</th>
<th>Organizational Culture Variables</th>
<th>Teachers’ Performance Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>0.831</td>
<td>0.903</td>
</tr>
</tbody>
</table>
This result shows that three variables in this study have $Asymp.Sig > 0.05$. This means that the data are in the normal distribution.

### 2.6.2 Linearity Test

A linearity test was used to test the correlation between the independent variable and the dependent variable. If the value resulted shows $F_{count} < F_{table}$ with significance levels 5% and 1%, there is a linear correlation. The formula and calculation are presented below [39].

$$F = \frac{s_{reg}^2}{s_{sis}^2} (F_{Count})$$

Information:

- $F = F_{count}$
- $s_{reg}^2 = \text{regression variation}$
- $s_{sis}^2 = \text{remaining variation}$

The result of the calculation is presented in Table 5 below:

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructional Leadership*Teachers’ Performance</td>
<td>0.873</td>
</tr>
<tr>
<td>Organizational Culture*Teachers’ Performance</td>
<td>0.818</td>
</tr>
</tbody>
</table>

The result shows that all variables have significance values higher than 5%. This means that all variables have a linear correlation.

### 2.6.3 Multicollinearity test

This study employed a Variance Inflation Factor (VIF) equation to test multicollinearity. This test aimed to determine whether there was a correlation between independent variables. A good regression model should show no correlation. Multicollinearity refers to the Tolerance value > 0.10 or equal to VIF < 10 [42]. The result of the calculation is presented in Table 6 below.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Tolerance</th>
<th>VIF</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principal Instructional Leadership</td>
<td>0.212</td>
<td>4.722</td>
<td>Not Multicollinear</td>
</tr>
<tr>
<td>Organizational culture</td>
<td>0.212</td>
<td>4.722</td>
<td>Not Multicollinear</td>
</tr>
</tbody>
</table>

Based on the test result, there is no multicollinearity.
3 Results and Discussion

3.1 Regression Test Results

Table 7. Simple Regression Test Results of Hypothesis 1

<table>
<thead>
<tr>
<th>Source of Constants</th>
<th>Coefficient (K=-33,794)</th>
<th>R</th>
<th>R²</th>
<th>F</th>
<th>Sig</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principal Instructional Leadership</td>
<td>a= 0.870</td>
<td>.908</td>
<td>.825</td>
<td>1142.369</td>
<td>.000</td>
<td>Ha1 accepted</td>
</tr>
</tbody>
</table>

Table 8. Simple Regression Test Results of Hypothesis 2

<table>
<thead>
<tr>
<th>Source of Constants</th>
<th>Coefficient (K=-58,385)</th>
<th>R</th>
<th>R²</th>
<th>F</th>
<th>Sig</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Culture</td>
<td>a= 0.810</td>
<td>.896</td>
<td>.802</td>
<td>981.357</td>
<td>.000</td>
<td>Ha2 accepted</td>
</tr>
</tbody>
</table>

Table 9. Multiple Regression Test Results of Hypothesis 3

<table>
<thead>
<tr>
<th>Source of Constants</th>
<th>Coefficient (K=-55,624)</th>
<th>R</th>
<th>R²</th>
<th>t count</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principal Instructional Leadership</td>
<td>a= 0.512</td>
<td>0.929</td>
<td>0.863</td>
<td>10.30</td>
<td>9</td>
</tr>
<tr>
<td>Organizational culture</td>
<td>a= 0.381</td>
<td></td>
<td></td>
<td>1.17</td>
<td>8.117</td>
</tr>
</tbody>
</table>

3.2 Dominant Factors

Predictor contribution is the elaboration of the amount of the independent variable influence on the dependent variable in percentage. The contribution of predictors is categorized into two, namely effective contribution (SE) and relative contribution (SR). Effective contribution (SE) is the contribution of independent variables to the dependent variable in the regression analysis. The total number of all SE independent variables is equal to the value of R square (R²). Relative contribution (SR) indicates the amount of the contribution of the independent variables to the value of squared regression. The total of all SRs from the independent variables is 100% or equal to 1. The following table shows the amount of effective and relative contributions from the independent and dependent variables in this study.

Table 10. Effective and Relative Contribution Values

<table>
<thead>
<tr>
<th>Variabel</th>
<th>SE</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principal Instructional Leadership</td>
<td>48.6%</td>
<td>56.3%</td>
</tr>
<tr>
<td>Organizational culture</td>
<td>37.7%</td>
<td>43.7%</td>
</tr>
</tbody>
</table>

Total 86.3% 100%

These results indicate that the effective contribution (SE) of the independent variables in this study is 86.3%. This percentage is obtained from the SE of the instructional leadership variable.
of the principal of 48.6%, and the SE of the organizational culture variable of 37.7%. The remaining 13.7% is influenced by other factors.

Then, the relative contribution of the principal's instructional leadership is 56.3%, and the contribution of school organizational culture is 43.7%. From the value of the effective contribution (SE) and the relative contribution (SR) in the table, it can be concluded that the instructional leadership variable has a greater contribution to teacher performance than organizational culture does.

3.3 The Effect of School Principal Instructional Leadership on Teacher Performance.

The study finds that there is a significant effect of instructional leadership on teacher performance in public senior high schools located in Sleman Regency. The results of this study support the results of previous study conducted by Utari in 2019 [43]. This study is also in line with Wardani who adopts the leadership model developed by Hallinger and Murphy in 1985. Wardani suggests effective instructional leadership practices, namely: (1) interpreting the vision of the school together with school members and making optimum efforts to realize the visions and missions set, (2) involving stakeholders in education management, (3) supporting learning processes, (4) monitoring the teaching and learning process to be able to deeply understand and be aware of what is going on at the school, (5) acting as a facilitator to find out problems faced by teachers and helping them solve them. Furthermore, it is noted that if the principal does so, the teacher performance will improve [44].

3.4 The Effect of Organizational Culture on Teacher Performance

This study finds that the school organization culture has an effect on teacher performance in public senior high schools located in Sleman Regency. The results of this study are in accordance with the research before. The research show that organizational culture has a strong influence on teacher performance [45][46]. Further, the results of this study show that the contribution of organizational culture to teacher performance is 37.7%. This means that 62.3% of teacher performance is determined by other factors. The results of this study support experts’ views that there are various factors influencing teacher performance, namely salary, facilities and infrastructure, work environment, leadership, motivation, job satisfaction, job design, commitment, participation, etc [2], [3].

3.5 The Effect of Instructional Leadership and Organizational Culture Simultaneously on Teacher Performance

The study indicates that there is an influence of instructional leadership and organizational culture on teacher performance in public high schools. The results of this study are in accordance with the research conducted by Sitanggang, Sibuea, and Sitompul in 2017 stating that there is a positive influence of leadership and organizational culture on teacher performance. In this study, the R2 value is 0.863. This value shows that teacher performance is influenced by the variables of instructional leadership and school organizational culture by 86.3%. The remaining 13.7% is influenced by other factors [47].

4 Conclusions

The results of this study show that there is a significant effect of instructional leadership on teacher performance in public senior high schools located in Sleman Regency (48.6%). There is a significant effect of organization culture on teacher performance in public senior high schools located in Sleman Regency (37.7%) There is an influence of instructional leadership
and organizational culture on teacher performance in public high schools (86.3%). Instructional leadership and organizational culture have significant effects on teacher performance both separately and simultaneously. The simultaneous effect of two independent variables on teacher performance is greater. Therefore, this study suggests that instructional leadership should be performed along with the development of conducive school culture in order to improve effectively the quality of teaching-learning processes.

Acknowledgment. I dedicate this research to Yogyakarta State University, and principals of State Senior High Schools in Sleman Regency.

References

[22] HOY, W.K. and MISKEL, C. G. Educational Administration: Theory, Research, and Practice,


[38] Santosos, S. *SPSS Versi 11.5 Cetakan Kedua*. Jakarta: Gramedia, 2002.


[40] Sitanggang, S., Sibuea, A. M. and Sitompul, H. Pengaruh Kepemimpinan Pembelajaran,
Deconstructing Physics Problems Using Testlet Templates

Budi Naini Mindyarto¹, Sugiyanto Sugiyanto²
{budinaini@mail.unnes.ac.id¹, sugiyanto@mail.unnes.ac.id²}

Universitas Negeri Semarang, Sekaran Gunungpati Semarang, Indonesia¹,²

Abstract. Physics problems have been deconstructed into testlet items using templates. These items have been generated based on the functional requirements of a developed automatic item generator. Empirical testing needs to be conducted to verify the conformity with automatic item generation characteristics. This paper aims to address the extent of template compliance with the generator features. Black-box testing procedure was used to verify the function conformities by exploring the execution of the generator and its input and output. 25 Physics templates were examined. The testlet variants generated from the execution of the generator showed that the template characteristics adhered to the input requirements of the generator. It can be concluded that the validation of the testlet templates by the generator showed that the templates support the automatic item generation.

Keywords: physics problems, testlet templates, automatic item generation

1 Introduction

Traditional item development using a paper-and-pencil based manual process is not efficient. This is more pronounced when a large number of items are needed, such as to fulfill the demands of the items in parallel test packages or a question bank. Items are treated as isolated entities that are individually created, reviewed, and formatted. Because the items were developed individually, these items gave unpredictable statistical output because incidental and radical elements were not easily identified or understood. Automatic item generation (AIG) [1,2] can accommodate the deficiencies of traditional methods to generate items.

AIG is a process of using item models to generate test items with the help of computer technology. Computer-based algorithms are used to place the material into the item model through programming to generate items automatically. Without using any constraints, all the contents of the variables are combined systematically to generate items iteratively. Constraints are used to eliminate items that do not make sense or have no meaning.

The generation of items has been implemented for various purposes. Higgins, Futagi, and Deane [3] describe the ModelCreator for producing mathematical narrative questions, Higgins [4] presents ItemDistiller as a tool that can be used sentence-based items, Gierl et al. [5] describe the IGOR (Item GeneratOR) software to generate template-based items, Gutl et al. [6] describes the use of Enhanced Automatic Question Creator (EAQC) to retrieve key concepts from the text to generate multiple-choice items and constructed responses, Ferreyra & Backhoff Escudero [7] describe GenerEx to generate different versions of a basic
competency test, Kosh [8] creates AIG item models to assess middle school students’ algebraic reasoning, and Rambhau et al. [9] to generate MCQ with random answer key.

For objective items that present alternative answer choices where the testee is asked to choose one correct answer, the implementation of automatic item generation that has been done a lot is for the multiple-choice format. The response to this multiple-choice item is dichotomous. The design and implementation of the automatic item generation technique for the multiple-choice format have the potential to be modified to accommodate the generation of items for the testlet format that provides a polytomous response. The cognitive model will include the identification of the material to be tested, the development of cognitive processes that will be revealed, and the development of an item structure that covers the entire testlet. The author has developed a generator for producing testlet automatically.

The generator is an application program for generating testlet variants based on testlet models formatted in template forms. The program accepts and validates input in the form of a testlet template from the user, processes the testlet template into XML format, and generates testlet variants based on the testlet template and stored in the database. The testlet is a combination of multiple-choice items with both single correct answers (multiple-choice) and with multiple correct answers (multiple responses). The validation of the template’s functionality is presented in Table 1.

Table 1. Features of Testlet Template

<table>
<thead>
<tr>
<th>No.</th>
<th>Function Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Manually input the testlet template or upload a template (.docx).</td>
</tr>
<tr>
<td>2</td>
<td>Image files for the template are uploaded separately.</td>
</tr>
<tr>
<td>3</td>
<td>Images can be used in stem and options.</td>
</tr>
<tr>
<td>4</td>
<td>Numeric expressions or formulas can be assigned to stem and options.</td>
</tr>
<tr>
<td>5</td>
<td>The key to the testlet question can be fixed or conditional.</td>
</tr>
<tr>
<td>6</td>
<td>The key to the testlet question can be single or multiple.</td>
</tr>
</tbody>
</table>

The author has developed physics testlet templates based on re-engineering the national exams of high school physics. Re-engineering is carried out with a motivation, namely stimulating the testee to carry out a qualitative analysis in solving quantitative physics problems. The stimulation is done by adding qualitative questions to the expanded context along with the reasoning questions. Re-engineering is carried out for problems concerning mechanics, namely for the topics of Kinematics and Dynamics, Elasticity and Hooke’s Law, Work and Energy, the Law of Conservation of Mechanical Energy, and Impulses, Momentum and Collisions. An example of the re-engineering testlet template is presented in Figure 2.

Physics testlet templates developed by re-engineering high school physics national exams need to be validated and verified so that they can be used to generate physics testlet variants automatically. The validation of these physics templates is determined through black-box testing by exploring the execution and input-output of the generator. The success of the validation of these physics templates is indicated by the generation of physics testlet variants by the generator. So this research aims to explain qualitatively the fit between the characteristics of the physics testlet templates and the features of the generator.

The validation and verification are testing steps against the physics testlet templates which were developed by re-engineering the physics national-exam questions. The testing step is in line with Bohdan & Vasyli’s [10] and Hamza & Hammad [11] statement that testing is an integral part of a development process that forms an important link in the overall development chain. It is expected that these physics testlet templates can be used appropriately with their
function as templates in automatic item generation and it is hoped that these physics testlet templates can also show this function correctly. The suitability of the characteristics of the physics templates with the generator features can be used as a reference for developing testlet templates for other domains of science.

2 Method

The research design was descriptive qualitative related to developing physics testlet templates. The templates focused on developing knowledge structures [12] through-provoking
The research description was obtained through functional testing or black-box testing (BBT), which verified the program's proper handling of external functions by observing program behavior during execution \([10,11]\). The program, which was the item generator, worked by combining the manipulative variables declared in the testlet templates to generate item variants. The form of BBT used was a checklist in the form of a functional specification that contained external functions that must be present and expected input-output information. The instrument facilitated the identification and verification of characteristic compatibility between the physics testlet templates and the generator in the perspective of automatic item generation. The procedure was to enter the templates into the generator, validate the templates, and generate testlet variants using the generator. The execution observation data was used to verify checklist items. This data was analyzed qualitatively to determine the fulfillment of templates with the generator features in the perspective of automatic item generation.

### 3 Results and Discussion

The data describing the functionality of physics testlet templates were obtained empirically by inserting testlet templates, validating, and generating testlet variants. The data were analyzed using a checklist analysis to match the characteristics of the physics testlet templates with the standard criteria, namely the generator features. The verification of the AIG perspective from these physics testlet templates was carried out based on the Table 1 criteria.

The generated items were automatically traced using manipulative variables in the physics testlet templates. The physics testlet variants were generated by the generator by combining all the values of all the manipulative variables used in the physics testlet template. For example, the selected testlet variants generated from the MEKAN01 testlet template and the values of the manipulative variables were presented in Table 2.

The MEKAN01 template used two manipulative variables (numeric: N1 and N2), two manipulative variables (string: S1, S3) and one conditional manipulative variable (image: S2). The values of the manipulative variables in Table 2 were substituted as a substitute for the manipulative variable codes that were in the MEKAN01 testlet template for each testlet variant. A snippet of the serial number 13 testlet variant generated from the MEKAN01 testlet template was presented in Figure 4.
Table 2. Variation of Manipulative Variables for Several Variants

<table>
<thead>
<tr>
<th>Variant</th>
<th>Quantitative</th>
<th>Qualitative (what-if)</th>
<th>Scientific reasoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>N1=2; N2=1.8</td>
<td>S1 = ‘slide on a frictionless inclined plane’; S2 = ‘mekanik0102b.png’</td>
<td>S3 = ‘Supporting fundamental statements’</td>
</tr>
<tr>
<td>35</td>
<td>N1=3; N2=1.25</td>
<td>S1 = ‘slide on a parabolic trajectory without friction’; S2 = ‘mekanik0102c.png’</td>
<td>S3 = ‘Underlying principles’</td>
</tr>
<tr>
<td>48</td>
<td>N1=3; N2=3.2</td>
<td>S1 = ‘free dropped’; S2 = ‘mekanik0102a.png’</td>
<td>S3 = ‘Explanatory arguments’</td>
</tr>
</tbody>
</table>

Problem 13

An object with mass of 2 kg moves from point A at an altitude of 10 meters without initial velocity. If during motion there is no friction, the mechanical energy of the object when its height decreases by 1.8 meters from point A is:

A. 36 joule  
B. 164 joule  
C. 72 joule  
D. 328 joule  
E. 10 joule  

a) If the same object slides on an inclined plane without friction from the same height (h), then the mechanical energy of the block in the current lowest position is...

b) The basic statement which supports the ratio of the mechanical energy of the block at the lowest position is:

A. The masses of the two blocks are equal.
B. The blocks move from the same initial height.
C. Both blocks move without initial velocity.
D. Shorter beam trajectory.
E. The beam trajectory is longer.

Fig. 4. Testlet Variant Code 13 Generated from the Template MEKAN01

With five variables consisting of three manipulative variables and one conditional manipulative variables, the MEKAN01 template produced 54 testlet variants. The number of manipulative variables used per testlet template and the number of testlet variants generated by the generator from 25 physics testlet templates which were the objectives of this study were presented in Table 3.
Table 3. Distribution of Manipulative Variables and Variants per Template

<table>
<thead>
<tr>
<th>Sub-Topics</th>
<th>Template Code (Σ variables</th>
<th>Σ variants)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T1</td>
<td>T2</td>
</tr>
<tr>
<td>Kinematics and Dynamics</td>
<td>KINED-01</td>
<td>-02</td>
</tr>
<tr>
<td>Dynamics</td>
<td>372</td>
<td>472</td>
</tr>
<tr>
<td>Elasticity and Hooke's Law</td>
<td>ELAST-01</td>
<td>-02</td>
</tr>
<tr>
<td>Work and Energy</td>
<td>USAHA-01</td>
<td>-02</td>
</tr>
<tr>
<td></td>
<td>6360</td>
<td>9216</td>
</tr>
<tr>
<td>Law of Conservation of</td>
<td>MEKAN-01</td>
<td>-02</td>
</tr>
<tr>
<td>Mechanical Energy</td>
<td>5754</td>
<td>9384</td>
</tr>
<tr>
<td>Impulse, Momentum and</td>
<td>TUMBU-01</td>
<td>-02</td>
</tr>
<tr>
<td>Collisions</td>
<td>9312</td>
<td>6180</td>
</tr>
</tbody>
</table>

The number of testlet variants generated from the testlet template depended on the number of manipulative variables in the template and the number of values or value ranges of each manipulative variable. The distribution of the testlet variants for the 25 physics testlet templates as presented in Table 3 showed that the physics testlet templates already had an automatic item generation character where the templates were successfully validated and processed to generate testlet variants. The success of processing testlet templates as input and the variants of physics testlets generated by the generator program as output showed that the physics testlet templates had characteristics that match the input requirements of the generator program for AIG. The template characteristics and the input requirements of the generator represented the properties of creative task and generative task [14] of AIG.

The validation facts of the 25 physics testlet templates developed by re-engineering the national-exam physics questions and generating testlet variants using the generator showed that the physics testlet templates as templates in AIG were functional. The characteristics of the testlet templates were a sub of the features of the generator. The physics testlet template used three questions from the 10 item templates provided by generator. From the generator feature checklist table, physics testlet templates could be entered manually or uploaded templates in Word documents (.docx), image files for templates were uploaded separately, templates used images in stem and options, templates used numerical expressions or formulas on the stem and options, the template used the item keys that were fixed and conditional, and the item keys were single and multiple. The Physics testlet templates used a single testlet question key, namely the use of multiple-choice format testlet compiler questions with one correct answer. This single key was accommodated by the generator besides the use of multiple keys, namely the use of testlet questions with multiple-choice format with more than one correct answer.

BBT testing through controlled experiments during program execution of the 25 physics testlet templates was carried out to ensure that the physics testlet templates followed the functionality of the testlet generator. This test reveal the "demonstration of proper behavior" [10] from the generation of testlet variants based on physics testlet templates. The results of this test could be interpreted as providing evidence about the quality of the physics testlet templates from the re-engineering of the national-exam physics questions in the context of automatic item generation.
4 Conclusion

The success of validating the testlet templates as input and the variants of the physics testlets generated by the generator as output shows that the physics testlet templates have characteristics that match the features of the generator for automatic item generation. The testlet templates of the results of re-engineering of the national-exam physics questions conform to the functional specifications required by the testlet generator. The AIG perspective of the physics testlet templates has been verified by the generation of the testlet variant with the generator.

The suitability of the characteristics of physics templates with the generator features can be used as a reference for developing testlet templates for other physics subjects or other domains of science. The optimization of generator's features can be further explored in the development of testlet templates such as the use of multiple-choice multiple answer formats and the use of nested manipulative variables.

References

[10] Oliynyk B, Oleksiuk V. Automation in software testing, can we automate anything we want? :11.
Analysis of School Climate Factors as Predictors of Academic Achievement in Junior High Schools: A Literature Review

Marani Cahya Ningtias¹, Suyanto², Amika Wardana³, Deri Indrahadi⁴
{maranicaha.2019@student.uny.ac.id¹, suyan@gmail.com², a.wardana@uny.ac.id³, dindrahadi@gmail.com⁴}
Universitas Negeri Yogyakarta

Abstract. The idea that school climate is an essential construct in supporting academic achievement can be a benchmark in assessing the performance of the world education system. However, Studies on school climate indicators are well documented in the international literature, but Indonesian research on this subject is still minimal. This article aims to analyze the literature on school climate indicators that can predict student academic achievement in junior high schools. Sources of data used are books and journals that are relevant to the research theme. The results of the study show that a positive school climate can improve student academic achievement and school climate indicators that can predict junior high school student academic achievement, namely student disruptive behavior which includes aspects of bullying, student discipline includes late students and truant students, and learning activities include student cooperation.

Keywords: Academic Achievement, School Climate, School Climate Indicators

1 Introduction

Information about the quality of education becomes a benchmark in assessing the performance of the education system in each country. Academic achievement is one of the indicators in assessing the quality of education, therefore studies on academic achievement must be updated and developed. In addition to the changing trends in education globally, the findings of studies on academic achievement can also be used to make decisions and policies to improve the quality of education, especially in Indonesia (1). Academic achievement can be interpreted as the result of student learning achievement in the form of grades or scores after following the learning process which is summarized in the final report of each semester (2). The government's success in providing education is now not only measured by the average score of the National Examination (UN) results but also measured by the results of the PISA survey conducted by the Organization for Economic Co-operation and Development (OECD) (1). PISA is a program for the assessment of international students aged 15 years that surveys the extent to which students' knowledge, skills to participate in social and economic life in the country which are scattered around the world every 3 years (3). PISA measures academic abilities in the areas of reading literacy, mathematical literacy, and scientific literacy, and digs up demographic data related to students' psychology and background.
The country of Indonesia has participated in the PISA survey since the first PISA survey was conducted in 2000 until now. As a result of the latest PISA survey in 2018, the PISA score of Indonesian students in the language literacy category was ranked 74, mathematics literacy was ranked 73, and scientific literacy was ranked 71 out of 79 participants who took the PISA survey (3). These results indicate that the student's academic achievement has not been able to solve questions on international standard cognitive level. The results of the PISA assessment relate to 4 programs issued by the Ministry of Education and Culture (KEMENDIKBUD) which are called the Independent Learning Program, one of the contents of the policy, namely the National Exam (UN) will be changed to a Minimum Competency Assessment and Character Survey which emphasizes the ability to reason using literacy, numeracy, and character reinforcement (4). This latest policy will be held for the first time in 2021, with the aim of improving the quality of education in Indonesia.

In general, research related to student achievement collects the most recent data relating to data on academic achievement and the factors that influence it. Survey results from PISA show that students' backgrounds continue to influence their chances of benefiting from education and development in many countries (5). For decades, researchers in the social science field have tried to understand how a variety of factors influence student achievement (6). One of the factors that can affect student academic achievement is the school climate. School climate is an interpersonal relationship between teachers, students, and school staff (7). School climate is a broad multidimensional construction that represents the quality and character of school life (8). The term school climate is the same as the school environment, learning environment and school culture (3). The school climate includes the quality and character of school life which is reflected in the norms and values applied in schools, teaching and learning practices in schools, interpersonal relationships between school members, and the organizational structure of the school (9).

The pioneers of research on school climate, namely Halpin and Croft (1963), explain that school climate is a school personality that reveals teachers' collective perceptions of school routines affecting student attitudes and behavior (10). Psychological theory says that the school climate affects student psychology, a positive school climate will form an emotional attachment between students and teachers, this bond affects student academic achievement towards a better direction (11). A positive school climate can be a key factor in efforts to improve student academic achievement (12).

The idea that school climate is important in supporting student academic achievement can be seen from the results of research that are well documented in international literature (13). In general, there is no consensus on the definition of school climate, school climate dimensions, measurement units, and analysis which results in different definitions and units of measurement for each study (14). The lack of research on how school climate indicators affect student achievement in Indonesia, because the majority of research focuses only on identifying problems in principal management and teacher satisfaction (15),(16),(17),(18).

A positive school climate can create a comfortable, safe, and conducive learning atmosphere if the interpersonal relationships between school members are well established. Studies on school climate indicators are well documented in international literature, but in reality in Indonesia, research on this is still very minimal. The focus of researchers is only on principal management and teacher satisfaction, thus causing researchers to find difficulties in identifying school climate indicators in determining student academic achievement. From the background description above, this study aims to find out more about the influence of school climate on student academic achievement and indicators of school climate in influencing student academic achievement.
2 Method

The research design used in this paper is the Literature Review. A literature review is used to collect data or sources related to the research theme. This research resulted in a review of quantitative and qualitative research obtained from books and international journals from Google Scholar, Sagepub Journal, Taylor & Francis Online. These sources are used to see how school climate affects student achievement from various studies. The keywords used are school climate, learning achievement, the factors that influence the school climate which is positive in increasing student achievement.

The literature review data analysis technique was synthesized using a narrative method by grouping similar extracted data according to the measured results to answer the purpose of writing this article. The data analysis technique from the literature review used by the majority of researchers used descriptive analysis, linear regression test, multiple linear regression test, simple linear regression test, two-stage multiple regression analysis, bootstrap mediation analysis, classical test theory (CTT), hierarchical linear. Model (HLM) and Meta-analysis.

3 Results and Discussion

The results of Wibowo et al's research in 2020 show that the school climate has a positive impact on the academic achievement of junior high school students in Indonesia (19). The results of the research by Hultin et al, stated that school climate has a positive correlation with the academic achievement value of junior high school students in Swedia (20). The results of Giez & Mcintosh's research, revealed that school climate is significantly associated with student academic success in Canada (21). The results of Eugene's 2020 research, said that the school climate variable (perceptions of school safety and student teacher relations) was significantly and positively related to the academically oriented high school program of students in the United States (22). The results of Konold et al's research in 2018, show that a positive school climate makes students in America more involved in school and higher academic achievement by schools (23). The results of research by Aldridge et al in 2013 showed that school climate is closely related to student academic success in Australia and affects student emotional behavior and the success of school reform (24).

The results of a 2016 study by Cornell et al. Revealed that a good school climate can increase the developmental pressure of early adolescents and protect against decreased student motivation and academic achievement in the United States, because a strict school climate and supportive teacher-student relationships can increase engagement, high students, and high learning outcomes, and high aspirations for education (25). The results of research by Davis et al. In 2015 show that school climate is an important factor related to student achievement in New York (6). Ozgenel's research results in 2020, show that a positive school climate has an impact on the performance of administrators, educ

ators and employees in schools which leads to increased student achievement in Turkey (26). The results of research by Sanders et al in 2018, stated that a positive school climate also affects the academic achievement of students with disabilities in the United States (27). Galetta's research results, A in 2017, found that school climate has a significant and positive relationship with student achievement in Ethiopia, but the correlation is weak (28). In general, the findings from this literature study state that there is indeed an influence between the school climate and academic achievement in various countries, because the school climate can make
the emotional bonds of students and schools tighter so that anything related to school makes students enthusiastic about participating in it. This will affect the student's academic achievement in a better direction. The results of research on school climate from 2013 to 2020 show that school climate does affect student academic achievement, however there are several studies in several countries that say that the contribution of school climate has a weak correlation.

The school climate is divided into two types, namely a positive school climate and a negative school climate. The indicators of positive school climate in measuring student academic achievement vary in each study. Salle 2018 measures student academic achievement into 4 indicators, namely student safety, school environmental conditions, peer and adult relationships, and learning activities (29). Wibowo 2020 measures student academic achievement with indicators of the relationship between students, staff and teachers, safety during the teaching and learning process, and the atmosphere of the school environment (19). Thapa & Cohen in 2013 measured student academic achievement with 5 indicators, namely student safety, relationships between school members, the learning process, the organizational environment, and the school improvement process (30).

Katsantonis 2020, measures student academic achievement with 4 indicators, namely security, the learning process, the school community and the organizational environment (13). Lewno et al in 2020, measure student academic achievement with 5 indicators, namely security, interpersonal relationships, learning process, organizational environment and school improvement process (8). Sanders in 2018 measures student academic achievement with 3 indicators, namely security, feelings of security and student emotion and teacher expectations (13).

PISA Results in 2019 measure student academic achievement with 9 indicators into 3 categories, namely first, disruptive behavior in the student environment which includes aspects of bullying, discipline and late behavior and truancy; second, the teaching and learning environment which includes indicators of teacher enthusiasm, teacher support, teaching practices and teacher behavior; third, the school community environment includes indicators of competition, cooperation, a sense of school ownership, and parental involvement (3). Zysberg & Schwabsky in 2020 measured student academic achievement with 3 indicators, namely interpersonal relationships, violence, and a sense of belonging (31).

Cocorada et al 2017, measuring student academic achievement with 7 indicators into 3 categories, namely student and teacher relationships, principal participation, student interaction, school satisfaction, school achievement motivation, relationships between teachers, and safety of citizens at school (32). Negative school climate can be measured using 9 indicators, namely student tardiness, student absence, dropout students, student concern, parental participation, minimal teaching materials, insufficient teacher resources, student readiness to learn, student health conditions (33). Indicators in measuring school climate which are predicted to affect student academic achievement have been suggested by several researchers. There are various indicators in researching school climate, the majority of researchers use school climate indicators rather than negative school climate indicators.

In teaching and learning activities, of course, always expect maximum learning outcomes (2). Analogically, school climate refers to patterns of daily social interactions at school (23). School climate reflects the situation of students, school staff, and parents, experiences about school life socially, emotionally, and socially as a step in increasing academic achievement (30). Studying the impact of school climate on student academic achievement and identifying the factors that shape the school climate can be used as benchmarks in planning and designing appropriate strategies to improve a positive school climate and student academic achievement.
A positive school climate is an effort to improve the quality of learning to achieve superior academic achievement. A positive school climate can improve or limit the performance of teachers and other school staff members. A positive school climate can support fostering good relations between school principals and teachers to create a good school climate and improve student academic achievement. From several studies on positive school climate, it can be concluded that in general a positive school climate can affect student achievement. In addition, a positive school climate can also influence students' emotions, behavior, reduce the harmful effects of low SES, increase the developmental stresses of early adolescence and increase student contributions to school activities. However, some research results reveal that school climate and academic achievement have a significant relationship. However, this correlation is still weak or low because it indirectly affects academic achievement.

The impact of a positive school climate is that it can improve student academic achievement, improve student morale and social behavior, minimize bullying in schools, reduce teacher stress and increase teacher job satisfaction in schools. Meanwhile, the problematic school climate was detrimental to the academic performance of black students, especially on math outcomes. Students who often arrive late, skip school, drop out of school, student apathy, lack of parental involvement, and lack of materials and resources, teachers, students not ready to learn, and students' poor health. A poor school climate increases the risk of student absence and impacts student achievement and risk of dropping out. School climate indicators that can predict high school student academic achievement are student safety (bullying, truancy, being late), interpersonal relationships (teachers, principals, students, teachers), participation (feelings of belonging to school, competition, cooperation, parental involvement). The three sub-factors of school climate construction emphasize school academics as an interpersonal orientation in school, an assessment of quality and consistency, and an understanding of norms, values, and behavioral goals.

In reforming education, the relationship between school climate and academic achievement is important to study because the demands for educational standards at the local and international levels are very high.

4 Conclusion

Based on a literature review from 2013 to 2020, it can be concluded that the school climate is a picture of life in schools including the relationships between school members. A positive school climate can affect student academic achievement in a better direction. The definition of school climate in Indonesia is more familiarly called the school environment or the atmosphere in the school. Indicators of school climate in affecting academic achievement consist of various kinds. The results of the study show that a positive school climate can improve student academic achievement and school climate indicators that can predict junior high school student academic achievement, namely student disruptive behavior which includes aspects of bullying, student discipline includes late students and truant students, and learning activities include student cooperation.

Acknowledgments. I dedicate my gratitude to previous researchers who have contributed to the results of their research as relevant literature in this literature review, and to the supervisory lecturers, the head of the study program, and friends of the Yogyakarta state university social studies study program who have helped in completing this article. May Allah repay his kindness many times over. Amin
Reference


[31] Zysberg L, Schwabsky N. School climate, academic self-efficacy and student achievement. Educ Psychol. 2020;0(0):1–16.


Analysis of Student's Critical Thinking Ability Based on Gender

Muthiah Fildzah Noverli1, Endang Cahya2
{muthiahfn@upi.edu, endangcahya@gmail.com2}

Mathematics Education Department, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia1,2

Abstract. This study aims to determine the analysis of student’s critical thinking ability based on gender in the arithmetic sequence and series material at MTs Negeri 1 Palembang. This study’s type is a qualitative descriptive study. This study was performed with a population of seven classes and a sample of one class, namely class VIII D, in the odd semester of the 2018/2019 academic year. Data collection techniques used documentation, tests, and interviews. At the same time, the test data analysis technique used descriptive narrative. Based on the research results, the results obtained: 1) Female students have higher critical thinking ability than male students in arithmetic sequence and series material. This is because female students have more complex thoughts than male students. 2) Male students are slightly superior by 10% over female students in achieving conclusions. 3) Male and female students have the same ability in indicators to make further explanations.

Keywords: Critical Thinking, Gender, Arithmetic Sequence and Series

1 Introduction

Mathematics as a science discipline that relies on the process of thinking is deemed very good to teach the students. It contained a variety of aspects that substantially lead students to think logically according to patterns and rules that have been arranged by default. So often, the purpose of teaching mathematics is not another to get used to that students were able to think logically, critically, and systematically [21]. This is following the Regulation of the Minister of Education and Culture of 2016 number 21 concerning Content Standards, which states that the purpose of learning mathematics in schools is that the students can show the attitude logical, critical, analytical, meticulous and conscientious, responsible accountable, responsive, and do not easily give up in solving the problem.

Critical thinking is indispensable for students' lives; by thinking critically, they can filter information, choose between appropriate or not a need, question the truth, and all things that can be a harmful impact on their live [21]. Critical thinking is a method used in mental activities that is guided and straightforward and solves problems, makes decisions, persuades, believes, and performs scientific research [10]. While the definition of critical thinking, according to Adinda [1], contains three things. First, in the sense of dealing with oneself, the world of others, or their environment, critical thinking is a problem-solving technique. Second, critical thinking is a method of reflective reasoning based on previously collected, concluding data and assumptions. Third, critical thought ends with the conviction and implementation of choices.
Improving critical thinking skills requires a good learning process. Surna and Panderiot [20] said that each student had individual differences that will affect the learning process. The individual differences of learners consist of intellectual, cultural, socio-economic, and gender backgrounds.

Some researchers claim there are gender-based disparities in mathematical skill. Based on the [13] PISA (Program for International Student Assessment) in 2015, on the subjects of mathematics, female students in Indonesia slightly outperformed male students, namely with a score of 387 for female students and a score of 385 for male students. Differences of this indicate that there is an interest, talent, style of learning that is diverse and ability is hidden students Indonesia in studying mathematics.

One of the mathematical abilities is critical thinking. The critical thinking process of students has differences between each individual. Male and female students can go through 4 phases of the critical thinking process: the recognition phase, analysis phase, evaluation phase, and thinking about alternatives. However, in the recognition phase, male students had trouble, namely incomplete in stating questions. Then, in the analysis phase, evaluation phase, and thinking about alternatives, both male and female students can do it well [2]. This reinforces the statement that female students are superior to male students in mathematics, which is influenced by their critical thinking abilities.

However, there are different statements regarding the comparison of these critical thinking abilities. According to Santrock [15], male students are a little better than female students in math and science. The ability of male students is the same as female students. Still, male students have better abstraction power than female students do, which allows male students are better off than female students in mathematics. Because, in general, mathematics is concerned with abstract notions. Martin, et al [11] has a similar result to Santrock. He found that in 21 countries, boys performed better at the grade 4 level than girls on various subjects, while the mean score for girls in seven states was higher than for boys. Rodriguez, et al [14] conclude that: (1) in most countries, girls in grade 4 show a lower self-concept in mathematics, although the effect of mathematical achievement is taken into account; (2) not only in countries where girls performed less well in mathematics than boys, but also in countries where girls performed more or less well than boys, girls viewed their mathematical abilities more negatively compared to boys. Zawistowska and Sadowski [22] showed that women are distracted from mathematics-related employment by a relatively low likelihood of alternate track failure.

The situation when male students are a little better than female students in math is caused by some factors like confidence and linking in mathematics. Ganley and Lubinski [6] found that in third through eighth grades, girls are less optimistic and less interested in mathematics than boys. Some researchers also assume that the effect of mathematical gender factors are triggered by biological differences in the brains of boys and girls, which are understood through observation, that in the fields of language and writing, girls are usually superior, whereas boys are superior because of better spatial abilities in mathematics. Ingalhalikar et. al [9] have found differences in brain function in men and women. The male's brain is optimized for intrahemispheric and the female brain for interhemispheric communication. The male brain is designed to encourage connectivity between perception and concerted action, while the female brain is designed to facilitate coordination between modes of analytical and intuitive processing.

Problems with arithmetic sequence and series material can show students' critical thinking abilities or abilities [3]. This is because the material for arithmetic sequences and series can be more easily made into critical thinking problems. Therefore, researchers are
interested in examining the analysis of student’s critical thinking abilities based on gender on the arithmetic sequence and series material that is to demonstrate a student's critical thinking ability.

The formulation of the problem in this study is how to analyze student’s critical thinking ability based on gender on the arithmetic sequence and series material at MTs Negeri 1 Palembang? Then, the purpose of this study is to find out how the analysis of students' critical thinking abilities based on gender in the arithmetic sequence and series material at MTs Negeri 1 Palembang.

2 Method

This research type is a qualitative descriptive study. Based on the opinion of Satori and Komariah [17], Saryono [16] and Sugiyono [19], it is concluded that qualitative research is research that aims to analyze and describe an object based on its quality and the researcher as a vital instrument of the research itself. The subject of this research was carried out purposively, namely 20 male students and 20 female students of class VIII MTs Negeri 1 Palembang for the 2018/2019 academic year. The goal of this research was to see the critical thinking ability of male and female students so that purposive sampling was focused on the high mathematical skills of the students.

Documentation, test, and interviews were data collection methods used in this study. Documentation is done to get an overview of student's critical thinking abilities. The test was then used to collect research data regarding the critical thinking levels of female students and male students in arithmetic sequence and series material. The test questions are based on critical thinking indicators. The test questions are in the form of essay questions with a total of 5 questions. Then, interviews are conducted to obtain information that cannot be obtained from tests and documentation.

This is because researchers want to capture students' perceptions, thoughts, and opinions about the material that has been taught. After that, the data will be processed. The processing of the data itself is calculating student scores, recapping student scores, calculating the average value of students, calculating the percentage of students' critical thinking abilities, and percentage descriptive analysis.

3 Result and Discussion

After a test given to students in the form of questions about critical thinking abilities, the percentage of critical thinking abilities of male and female students per predictor can be seen in diagram 1, which is calculated based on the criteria for scoring the critical thinking abilities of students.
The critical thinking abilities of male and female students are spread out in three indicators, namely very high, high, and low. Male students' critical thinking ability to provide simple explanations and build necessary skills is included in the very high category, determining strategies and tactics, making further explanations, and making conclusions included in the low category. Meanwhile, in providing simple explanations and building necessary skills, women students' critical thinking abilities are included in the very high category, determining strategies and tactics included in the high category, making further explanations, and making conclusions in the low category.

Based on the results of the data analysis of student’s answers to the critical thinking abilities test questions on the arithmetic sequence and series material in class VIII D MTs Negeri 1 Palembang, in the following table, the results of the students' critical thinking skills test can be seen:

<table>
<thead>
<tr>
<th>Score (X)</th>
<th>Category</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>81,25 &lt; X ≤ 100</td>
<td>Very High</td>
<td>3</td>
<td>15%</td>
</tr>
<tr>
<td>71,5 &lt; X ≤ 81,25</td>
<td>High</td>
<td>6</td>
<td>30%</td>
</tr>
<tr>
<td>62,5 &lt; X ≤ 71,5</td>
<td>Average</td>
<td>3</td>
<td>15%</td>
</tr>
<tr>
<td>43,75 &lt; X ≤ 62,5</td>
<td>Low</td>
<td>8</td>
<td>40%</td>
</tr>
<tr>
<td>0 &lt; X ≤ 43,75</td>
<td>Very Low</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

From table 1, it can be seen that there are no students who have critical thinking abilities with a deficient category. Students' critical thinking abilities are divided into four categories: high, high, medium, and low. Three-person students (15%) and nine female students (45%) have very high critical thinking abilities, six-male students (30%) and five female students...
(25%) have high critical thinking abilities, three-person students - Male (15%) and four-female students (20%) had moderate critical thinking abilities, eight-male students (40%) and two female students (10%) had low critical thinking abilities. These results prove that the students' critical thinking abilities between boys and girls are different in the arithmetic sequence and series material.

The results of the interviews also confirmed the test results. At the time of the interview, the answers from female students were more detailed than that of male students. One example is when asked about other formulas from finding the sum of the first $n$ terms of an arithmetic series, female students still try to remember a little about the formula even though in the end they fail to pronounce the formula correctly in contrast to male students who tend to give up immediately to remember the formula. Female students also had exciting answers when asked for examples of arithmetic sequences in real life, even though they were still not quite right.

Female students have higher critical thinking abilities than male students. This statement is supported by Dahlan’s statement [4] that boys from a young age until the age of 18 had their right brain developed first, while girls from a young age to 18 years of age both their right brain and left brain developed simultaneously. According to Munawaroh and Haryanto [12], the left brain functions for rational, analytical, sequential, linear, and scientific thinking, such as learning to read, language, count, spatial, and metaphoric absorbing more synthetic mathematical concepts.

Female students’ critical thinking abilities are higher than male students, which can also be supported by comparing the number of student frequencies per category of critical thinking abilities. In a very high category, female students' frequency is more than the frequency of male students. Then, in the low category, male students’ frequency is more than the frequency of female students. Whereas in the high and medium categories, there was no significant difference in frequency between male and female students.

The results of female students' high critical thinking abilities are also because they excel in achieving three indicators of critical thinking abilities, namely providing simple explanations, building necessary skills, and determining strategies and tactics. This is confirmed by the statement of Fajari et. al. [5], which states that the critical thinking process of female students is more complicated than male students because female students fulfill the characteristics of reflective and rational thinking. Meanwhile, male students are only able to fulfill the characteristics of rational thinking. In line with the statement of Fajari et al., The results of research conducted by Haryani [8] also stated that female students fulfill all aspects of critical thinking at every stage of problem-solving.

However, even though the results of women students' critical thinking abilities were higher than men students, the percentage of achievement of the indicators made conclusions that women students had a lower percentage value of achievement than the percentage value of achievement of male students. Many female students do not work on questions containing indicators to make conclusions, which are theoretical questions. This shows that Hardy et. al. [7] stated that women tend never to have a broad interest in theoretical problems like men.

The interview results also reinforce this. More female students answered that the statement on the test questions about making inferences did not apply if the numbers in the arithmetic series were multiplied by another number. Their answers showed that they did not fully understand the arithmetic sequence concept, and we're still lacking in making conclusions. This result is also strengthened by the statement of Siswandi et. al. [18] that the types of errors of female students are misunderstanding, transformation errors, errors in the completion process, and errors in determining the final answer.
Thus, it can be concluded that female students have higher critical thinking abilities than male students. Female students scored higher percentages on indicators providing simple explanations, building necessary skills, and determining strategies and tactics. Male students had a slightly higher critical thinking ability than female students on the indicators of making conclusions. Meanwhile, in the indicator making further explanations, male and female students achieved the same percentage value. This same considerable percentage value shows that Fajari et. al. [5] states that there is no difference between male and female students in critical thinking.

4 Conclusion

Based on the theoretical study and analysis of the research results stated previously, it can be concluded that male students and female students have different critical thinking ability. Female students have higher critical thinking ability than male students. Female students scored higher percentages on indicators providing simple explanations, building necessary skills, and determining strategies and tactics. This is because female students have more complex thoughts than male students. Then, male students have a slightly higher critical thinking ability than female students’ on making conclusions. This is because making conclusions requires a reasonably good interest in theory. Meanwhile, women tend to have less interest in theoretical matters, so that most female students do not solve theoretical problems. Finally, in the indicator making further explanations, male and female students achieved the same percentage value. This is because basically, the abilities of male students and female students are the same.

References

Improving Constructing Explanations and Designing Solutions Skills based on NGSS through Project-Based Learning: A Systematic Review

Novia Rhike Dyah Pitaloka¹, Suyanta², Khoirul Huda³

{noviarhike.2019@student.uny.ac.id¹, suyanta@uny.ac.id², khoirulhuda.2019@student.uny.ac.id³}


Abstract: Constructing explanation and designing solution (CEDS) skills focus on skills in next generation science standards (NGSS) which describe science and engineering objectives that can be supported by project-based learning (PjBL). The purpose of this study to determine if the PjBL could improve CEDS skills. The research method used meta-synthesis approach and the data comes from the results of research that has been conducted and published in national and international online journals. The results of a systematic review explain that learning steps in PjBL can be implemented in learning to improve skills in a claim, evidence, reasoning, generate designing solutions, criteria-constraints, and evaluating potential solutions. PjBL provides opportunities for students to access various forms of information needed and demonstrate it in different ways; actively involved in learning by making choices and decisions that show independent learners, and reflect on learning and make revisions based on self-assessment and feedback from the teacher.

Keyword: NGSS, constructing explanations and designing solutions, project-based learning

1. Introduction

The development of science and technology marks the 21st Century is overgrowing, emphasizing the combination of technology and human qualities. Requires human resources who can take the initiative, think critically, creatively, skilled in problem-solving, also to changes in the education system that is more comprehensive and flexible. Quality education certainly involves students to learn actively and make changes to better conditions. Science education, which is the main focus, plays a role in preparing students to understand the nature of science, think critically, and have the skills to meet the challenges of the 21st Century [1][2].
The low level of human resources in Indonesia shows the low quality of education as a producer of skilled and quality generations. The results of the Program for International Student Assessment (PISA) in 2018 the ability of Indonesian students, especially in the field of science, got a score of 396 from the international standard score of 489 [3]. Indonesia is at level 1, meaning that students can identify information and solve problems according to explicit instructions and have not been able to carry out procedures properly, including methods that require sequential decisions [3]. Causes the emergence of problems in science process skills that affect student’s creative thinking abilities. To be able to develop and improve student science skills, a teacher must carry out various innovations and reforms in education. Such as adopting education standards from a superior country, namely the Next Generation Science Standard (NGSS). Related to how can put science into practice, NGSS facilitates students through the integration and implementation of three NGSS dimensions, namely the dimensions of Science and Engineering Practice (SEPs), Disciplinary Core Ideas (DCIs), and Crosscutting Concepts (CCs) [1] [4].

One of the objectives of NGSS is to optimize student practice skills by constructing explanations and designing solutions (CEDS). CEDS is a skill in explaining phenomena based on evidence from research and designing solutions to formulate conclusions [5]. Skills that focus on explanation as a manifestation of the nature of knowledge in constructing explanations related to phenomena through an investigation [6]. Meanwhile, the gift of designing problem solutions plays a role so that students can do research, innovate, and solve problems [2].

PjBL can support the application of CEDS in learning by selecting an appropriate learning model, namely Project-based learning (PjBL). A learning model that allows students to develop creativity in designing and doing projects that use to solve problems [7]. PjBL will enable students to become interactive learners and build knowledge through exploration that allows students to demonstrate organized learning outcomes to increase their knowledge and progress in learning [8]. This is consistent with the application of PjBL in science learning which is known to improve cognitive learning outcomes and science process skills [9] [10].

PjBL supports the process of finding truth through a process of inquiry to answer questions about natural phenomena and engineering that are more focused on solving problems through a series of design processes, so that students can increase understanding with the knowledge found [11]. Integrating design activities in the NGSS carried out in the PjBL learning model can enable students to be involved in defining problems and designing solutions [12]. Based on the description above, it can be a significant finding when researchers can implement NGSS standards in project-based learning to improve CEDS. So, the research problem arises how can the results of a review project-based learning model can be enhanced CEDS skills?

2. Method

This research is a systematic review that is used to collect data or sources related to a particular topic through journals, books, the internet, and other literature. This type of research used in the review literature focuses on research results related to the topic or variable of writing, using the meta-synthesis method with a meta-ethnographic approach which aims to develop new theories to complement existing theories. The outcome measured in this study was a project-based learning model in improving CEDS skills. This research used the meta-synthesis method consisting of 6 steps which were adopted from Francis & Baldestari (2006). These steps are: (1) Formulating research
questions (2) Conducting systematic review literature searches (3) Screening and completing suitable research articles (4) Conducting analysis and synthesis of qualitative findings (5) Implementing quality control (6) Developing final report [13].

The first stage is to formulate questions on the research topic, how can the results of a review project-based learning model improve CEDS skills? The second stage is to conduct a systematic review literature search, the data used in this study come from the results of research that have been conducted and published in national and international online journals. In this study, researchers searched journals published on the internet using the Google Scholar search engine, the Education Resources Information Center (ERIC), and Taylor and Francis. The third stage, screening and selecting articles begins with determining the keywords to be used. These keywords are next generation science standards, constructing explanation - designing solution, and project-based learning. The process of collecting data by filtering based on criteria determined by the author of each journal taken. The criteria for journal collection are the years of literature sources taken from 2010 to 2020, the suitability of writing keywords, interest in writing results, and discussion and strategies for collecting various literature using an accredited journal site.

The fourth and fifth stages, namely analyzing and synthesizing findings and enforcing quality control, are carried out when selected articles have gone through the screening stage which is then analyzed by experts in the field of articles related to quality, data accuracy, and quality-focused research questions. The sixth stage is compiling the final report which is done by writing the results of the review. This literature review is synthesized using a narrative method by classifying similar extracted data according to the measured results to answer the research problem. The results of the extraction of the journal are then analyzed for the content contained in the research objectives and the results/research findings. The analysis used to analyze the contents of the journal was carried out using coding. The data that has been collected is then searched for similarities and differences and then discussed to conclude. The remainder of the article is organized as follows: part 3 as a result and discussion presents a review of project-based learning which is can improve constructing explanations and designing solution skills based on NGSS. Section 4 concludes from the articles that have been prepared.

This research begins by searching for journal articles through three online search engines source; there are Google Scholar, Taylor & Francis, and the Education Resources Information Center (ERIC) in Table 1.

<table>
<thead>
<tr>
<th>Key Word</th>
<th>GS</th>
<th>Taylor &amp; Francis</th>
<th>ERIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructing explanation</td>
<td>1.050.000</td>
<td>612</td>
<td>247</td>
</tr>
<tr>
<td>Designing solution</td>
<td>4.280.000</td>
<td>493</td>
<td>193</td>
</tr>
<tr>
<td>Project-based learning</td>
<td>5.110.000</td>
<td>611</td>
<td>18.780</td>
</tr>
</tbody>
</table>

Based on three online search engines source, it found that Google scholar has a much higher number than Taylor & Francis and ERIC (Table 1). However, if we look at the quality of the articles, Tailor & Francis and ERIC are higher than Google Scholar. Based on the papers have gone through the screening stage, the next step is to answer the research problem that have to ask. However, improving constructing explanations and designing solutions skills based on NGSS through project-based learning has never been done, so it will be a very big opportunity for further researchers to continue research by this topic.
3. Result and Discussion

3.1 Constructing Explanation and Designing Solution Skill

CEDS skills are one of the skills in the scientific and engineering practice dimension that describes the achievement of the main goals of science and engineering [4]. Students involve themselves in various practical activities that will understand that science and engineering are a process to develop an explanation and formulate solutions to every problem [14]. NGSS Lead State (2013) describes CEDS skills into one unit with the indicators shown in Table 2.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructing Explanation</td>
<td>1. Compiling a scientific explanation based on facts obtained from various</td>
</tr>
<tr>
<td></td>
<td>sources and assumptions that a theory and law that explains the mechanism</td>
</tr>
<tr>
<td></td>
<td>of nature in the past, present, and</td>
</tr>
<tr>
<td></td>
<td>2. Apply ideas, principles, and facts to construct and improve by using</td>
</tr>
<tr>
<td></td>
<td>scientific explanations to explain natural phenomena</td>
</tr>
<tr>
<td>Designing Solution</td>
<td>3. Apply science reasoning to show why can use data to conclude.</td>
</tr>
<tr>
<td></td>
<td>4. Apply ideas to design and test an object design.</td>
</tr>
<tr>
<td></td>
<td>5. Designing a project by applying design steps to formulate a solution</td>
</tr>
<tr>
<td></td>
<td>by the criteria.</td>
</tr>
<tr>
<td></td>
<td>6. Optimizing the way the design works</td>
</tr>
</tbody>
</table>

The development of constructing explanation skills provides an understanding of scientific concepts that will affect students in formulating a scientific explanation. The constructing explanation activity focuses on scientific explanations to describe the reasons for preparing a logical scientific explanation related to the observed phenomena [15]. The scientific explanation is organized into three main points. More detail in Table 3.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Claim</td>
<td>A statement that answers a question. Claims consider right when they can</td>
</tr>
<tr>
<td></td>
<td>answer questions that are supported by sufficient evidence and logical</td>
</tr>
<tr>
<td></td>
<td>reasoning.</td>
</tr>
<tr>
<td>Evidence</td>
<td>Evidence of scientific data to support the claim. Evidence that is meant to</td>
</tr>
<tr>
<td></td>
<td>come from observations or based on existing data, and is used to support the</td>
</tr>
<tr>
<td></td>
<td>formulated scientific explanation</td>
</tr>
<tr>
<td>Reasoning</td>
<td>A reason for linking data as evidence supporting a statement using proper</td>
</tr>
<tr>
<td></td>
<td>scientific principles based on scientific knowledge, theories, and models.</td>
</tr>
</tbody>
</table>

The use of a claim, evidence, and reasoning (CER) framework in learning can support CEDS skills, which will have an impact on students regarding their understanding of a scientific explanation and students are able to compile a scientific explanation [16]. If the teacher applies the CER framework in learning, students will get a firm understanding in compiling scientific explanation based on their knowledge [16]. Based on the CER framework described above [19], the constructing explanation aspect becomes more operational. More details in Table 4.
Table 5. The aspect of Designing Solution

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designing Solution</td>
<td>Generate design solution</td>
</tr>
<tr>
<td></td>
<td>Describe criteria and constraints</td>
</tr>
<tr>
<td></td>
<td>Evaluating potential solutions</td>
</tr>
<tr>
<td></td>
<td>Optimizing solutions</td>
</tr>
</tbody>
</table>

Table 6. Aspect and Indicator Constructing Explanation and Designing Solution

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Claim</td>
<td>1. Emphasizes the explanation of a phenomenon</td>
</tr>
<tr>
<td>Evidence</td>
<td>2. Presenting valid and reliable evidence to support a scientific explanation</td>
</tr>
<tr>
<td>Reasoning</td>
<td>3. Explain the reasons that link evidence to phenomena, based on scientific knowledge, theories, and models</td>
</tr>
<tr>
<td>Generate designing solution</td>
<td>4. Applying a scientific idea or principle to design a solution to a problem</td>
</tr>
<tr>
<td>Criteria and constraint</td>
<td>5. Describe the criteria and obstacles that may be faced in the selection of a problem</td>
</tr>
<tr>
<td>Evaluating potential solution</td>
<td>6. Evaluating various solutions and selecting the optimal solution.</td>
</tr>
</tbody>
</table>

3.2 Project-based Learning (PjBL)

Project-based learning is a form of student-centered learning based on three constructivist principles: specific and authentic learning, learning that allows students to be actively involved in the learning process, and learning to achieve learning goals through social interaction with various knowledge and understandings [20]. It is known that the challenges experienced by students that arise in designing affect the high level of student involvement [21]. PjBL is considered as a type of...
inquiry-based learning, where the context of education is provided through questions that lead to meaningful learning experiences [22].

The characteristics of PjBL focus on problem-solving and provide opportunities to work independently in building knowledge to produce products [24]. Based on this explanation, it can say that PjBL helps students learn independently and can convey the students' conceptual understanding systematically at certain levels [25]. PjBL explores in different phases of education, from early-stage to school to higher education. Learning steps using a project-based learning model based on The George Lucas Educational Foundation (2005) are as follows:

<table>
<thead>
<tr>
<th>Steps of PjBL</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) <strong>Start with the big question</strong></td>
<td>Learning begins with questions that encourage students to carry out an activity.</td>
</tr>
<tr>
<td>2) <strong>Design a plan for the project</strong></td>
<td>Planning is done based on discussions from students and teachers. It means that students feel responsible for the project. Planning contains the selection of projects, time to complete, and the tools and materials required.</td>
</tr>
<tr>
<td>3) <strong>Create a schedule</strong></td>
<td>Students and teachers should arrange a schedule of activities in completing the project. The scheduling must be precise because the completion of a project takes a long time. The teacher keeps reminding when student activities deviate from the project objectives.</td>
</tr>
<tr>
<td>4) <strong>Monitor the progress of the project</strong></td>
<td>The teacher is responsible for monitoring student activities by facilitating students in each process.</td>
</tr>
<tr>
<td>5) <strong>Assess the outcome</strong></td>
<td>Assessment carries out to help teachers measure the achievement of standards and provide feedback about the level of understanding that has been achieved by students. Product assessment carries when the group presents the final product.</td>
</tr>
<tr>
<td>6) <strong>Evaluate the experience</strong></td>
<td>Teachers and students reflect on the activities and project results that harry work. Students ask to share their experiences while completing the project.</td>
</tr>
</tbody>
</table>

There are four strategies in implementing PjBL in schools, there are 1) doing it in two ways; 2) recognize previous efforts; 3) make use of the word "and", 4) make the class an open place [27]. One way to avoid failure in implementing PjBL is that a problem solution is needed. Teachers can avoid common mistakes by following seven procedures adapted from Hung (2008) as follows: 1) determining the suitability of the material with PjBL; 2) analyzing the material; 3) write down potential problems; 4) describe potential solutions; 5) calibrate the project; 6) illustrates the task; and 7) reflect on learning [28].

### 3.3 Improving Constructing Explanations and Designing Solution Skill Through a Project-Based Learning

NGSS supports learning through the application of science and engineering practices based on project-based learning, performance-based assessments, and structured group work. Besides providing opportunities for students to solve real problems scientifically. For each activity unit creating a project allows students to 1) access various forms of information required; 2) actively
involved in learning that shows the results of independent learning, and 3) reflect on learning by making revisions based on peer and teacher assessments [29].

As we discussed above, the indicators for CEDS skills are claim, evidence, reasoning, generate a designing solution, criteria - constraints, and evaluating potential solutions. These indicators can be achieve using project-based learning methods. Project-based learning focuses on creative thinking, problem-solving, and student interaction to create and use new knowledge. For more details, the relationship between CEDS in NGSS and PjBL explain in Figure 1, as follows.

![Fig 1. Dependence CEDS Based on NGSS and PjBL](image)

The use of the PjBL model in learning that is in line with the NGSS as a way to strengthen science teaching for students. Apply project-based learning to be a very effective way to meet the demands of new standards. Also, it combines performance appraisal and effective work strategies to increase student involvement in the learning process. Thus, it can see the method required for implementing PjBL in improving practice required CEDS skills in Table 8.

<table>
<thead>
<tr>
<th>Steps of PjBL</th>
<th>Indicator CEDS</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential question</td>
<td>-</td>
<td>Provide questions that will lead students to the context of project-based learning and assign assignments to students to carry out controlled activities.</td>
</tr>
<tr>
<td>Design plan for a</td>
<td>-</td>
<td>Prepare a project plan that will w. Activities that will be carried out include: 1) determining tools and materials; 2) determine the rules of the game; 3) selection of activities to be carried out as answers to essential questions; 4) determine the implementation of the project with their respective duties and responsibilities.</td>
</tr>
<tr>
<td>project</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create a schedule</td>
<td>-</td>
<td>Make a schedule of activities to be carried out based on the actions to carry out by the plan.</td>
</tr>
<tr>
<td>Monitor and project</td>
<td>-</td>
<td>Performed as work control which is guidance from educators so that students carry out their activity correctly.</td>
</tr>
</tbody>
</table>

Table 8. Description Box of the PjBL in Enhancing CEDS Skills
Assess the outcome

**Assessment** is carried out on student work to measure student competency achievement.

**Constructing an explanation**
- **Claim**
  - Emphasize the explanation of a phenomenon
- **Evidence**
  - Presenting valid and reliable evidence to support a scientific explanation
- **Reasoning**
  - Explain the reasons that link evidence to phenomena, based on scientific knowledge, theories, or models

**Designing a solution**
- **Generate designing solution**
  - Apply a scientific idea or principle to design a solution to a problem
- **Criteria and constraint**
  - Describe the criteria and obstacles that may be in the selection of a problem
- **Evaluating potential solution**
  - Evaluating various solutions and selecting the optimal solution.

**Project evaluation**
- Reflect on project implementation.

---

The use of PjBL in improving CEDS skills see from the advantages of implementing PjBL, such as enhancing student skills in managing research. In finding solutions to project assignments, students can construct knowledge of various sources [30]. Meet the needs of students with different learning skill levels and techniques. One of the exciting things, why PjBL is essential to implement, is shown by several studies that show that students can implement PjBL with confidence and optimism that it can improve students' science process skills and creative thinking [31]. Also, found that 86% of the implementation PjBL was more effective than the application of traditional teaching approaches [10]. PjBL also has a significant effect on creative thinking skills and science process skills [32]. Can connect PjBL with NGSS in increasing students' appreciation of the importance of science in life, involving students in science practice and increasing student confidence in communicating scientific topics [33]. NGSS and PjBL prove to be attractive aspects for students in the world of education, this is by the statement [34] that through the NGSS platform students can become more motivated and inspired in the formal education system. This motivation and inspiration increase students ability to learn and increases their will to persist in their educational quest.

### 4. Conclusion

Based on the results of the systematic review which shows that CEDS skills can be improved, one of which is the application of PjBL in learning as evidenced by theory and several previous studies which are linked based on the results of the synthesis. To improve CEDS skills, educators can apply learning steps based on PjBL to meet skill achievements in CEDS, in the form of claims, evidence, reasoning, generate designing solutions, criteria - constraints, and evaluating potential solutions. PjBL also provides student learning experiences because students construct concepts from the projects they are working on.
References


An Analysis of the Conformity Level between the Importance Level and Program Performance at the Subject Teacher Forum

Prawidi Wisnu Subroto¹, Sigit Raharjo²
{prawidi.wisnu.s@gmail.com¹, sigitrarahjo42@gmail.com²}

Universitas Muhammadiyah Tangerang, Jl. Perintis Kemerdekaan I/33 Cikokol, Kota Tangerang, Banten, Indonesia¹²

Abstract. This present research aims at obtaining information about the conformity level between the levels of importance and performance of the teachers’ professional development program at the Subject Teacher Forum based on teachers’ perceptions. There are five research indicators, namely: program structure, administrator’s readiness, teachers’ needs, teachers’ motivation and institutional support. The research subjects were junior high school Mathematics teachers. The data collection technique used a questionnaire with a Likert scale, consisting of five importance level points and five performance points. This research analysis used a quantitative descriptive approach. The results point out that there are three indicators whose conformity level is above average (> 81%) and close to 100%, namely program structure, teachers’ needs and teachers’ motivation. The conclusion is that the level of conformity between the level of importance and program performance tends to be good. However, this program is necessary to improve institutional support and administrator’s readiness.

Keywords: program structure, administrator’s readiness, teachers’ needs, teachers’ motivation, institutional support

1 Introduction

Teacher is the main element and has an important role in realizing the quality of education. Therefore, for becoming professional educators, teachers are required to increase their capacity continuously. There are several competencies must be obtained by teachers through their professional education, such as pedagogical competence, personality competence, social competence and professional competence [1]. However, the fact shows that the teachers’ competence nationally still needs attention and improvement, especially in terms of pedagogic and professional abilities as it is reflected from the results of the Teacher’s Competency Test which do not show conformity with teachers’ performance in the working education field [2].

This phenomenon can also be seen from the results of the Junior High School Teachers’ Competency Test in Tangerang that their scores of pedagogic and professional competency reach an average of 60.54 [3]. This score is in the sufficient category and can still be better improved. These problems give the impression that the serious efforts of Junior High School Mathematics teachers in Tangerang, which have very good potential in developing their competence as teachers, are generally still not optimal.

A peer collaborative process at the Subject Teacher Forum (STF) becomes as one of various efforts to foster and to develop the teaching profession in Indonesia [4]. STF is a communication forum for teachers who teach the same subjects in a district/city. Here, they
can exchange experiences, have a consultation, are involved in educational trainings and seminars as well as explore ideas for solving problems in learning management.

Teachers’ professional development through coaching and training programs has often been reviewed by previous researchers. Among others are Gokmenoglu & Clark [5], Chien-Chin Chen [6], and Doherty [7]. These studies are more focused on revealing the extent to which teachers can achieve increased competence after participating in the program. Whereas this research focuses on uncovering the fundamental problems related to program implementation. Thus, this research finding can become as important information in improving the next STF activity program. The research problem is as follows: How is the conformity level between the level of importance and performance of the teacher professional development program at the STF? There are five indicators that are the focus of research, namely: program structure, administrator’s readiness, teachers’ needs, teachers’ motivation and institutional support.

In line with the background and research problems mentioned above, the purpose of this research is generally to obtain information about the level of conformity between the level of importance and performance of the teachers’ professional development program at the STF. Specifically, the purpose of this research is to gain information about the level of conformity between the level of importance and program performance viewed from the perspective of program structure, administrator’s readiness, teachers’ needs, teachers’ motivation, and institutional support.

The Subject Teacher Forum (STF) is a forum for teacher cooperation to collaborate in learning through activities that are initiated, implemented and evaluated together. This activity is carried out periodically with programs designed based on teachers’ needs and organized by STF administrators. The STF program is a teacher professional development program to improve pedagogical and professional competence. The curriculum implementation comprehensively can only be achieved by skillful teachers in subjects, pedagogical skills and learning management [8].

The structure of the Mathematics teacher professional development program at the Junior High School Mathematics STF in Tangerang comprises of training activities, seminars and sharing of experiences between peer teachers. There are eleven attributes of program structure indicators, namely: 1) ICT training for teachers; 2) question writing workshop; 3) classroom action research seminar; 4) simulation of learning models; 5) workshop for making props; 6) study of learning tools; 7) graduate competency standard exploring activities; 8) The activity of preparing the Final Semester outlines; 9) development of learning tools; 10) multimedia utilization activities; and 11) Olympic question making activities. For the program structure that has been compiled to be able to be implemented effectively and efficiently requires the administrator’s readiness to provide good supporting resources.

The administrator’s readiness determines the smoothness and effectiveness of the activities at the STF, including training activities, seminars and sharing of experiences between peer teachers. The in-service teacher training programs are conducted to link any program given to teachers who are already working in schools to update and to increase their knowledge, technical skills and so on [9]. Several factors that contribute to the effectiveness of in-service training are the administrator’s role, teachers’ attitudes, training needs and strategies for conducting in-service training [10]. In line with this opinion, Vaillant & Manso argue that training institutions must have the leadership, authority, budget, personnel, infrastructure, and resources for learning preparation to reach state standards [11]. The administrator’s readiness indicators comprise of five attributes, namely: 1) the suitability of programs and activity budgets; 2) the availability of media/activity aids; 3) the availability of materials/sources of
activities; 4) the socialization of the activity program; and 5) the evaluation of the previous activity program. The teacher professional development program through training must take into account and facilitate teachers’ needs to achieve the effectiveness of the program.

STF participants are teachers who have different backgrounds in teaching knowledge and experience, thus training activities need to accommodate their needs. STF administrators need to identify and to consider projected material activities needed by teachers. This is to accommodate previous teachers’ experiences, both in terms of knowledge and skills so that they can be more creative and innovative. According to Stronge cited by Sutopo, that the aspect of professional development refers to the need for development and improvement of teachers’s professionalism in carrying out their duties [12]. In addition, Kirkpatrick, James & Kirkpatrick, and Wendy state that learning is to what degree participants acquire the intended knowledge, skills, and attitudes based on their participation in the learning activity [13]. Indicators of teachers’ needs include four attributes, namely: 1) activity materials that can improve knowledge; 2) training that can improve skills 3) activities that can increase creativity; and 4) suitability of the activity material with the teachers’ needs. By fulfilling the teachers’ needs in training activities, teachers will be motivated to participate fully in activities.

Activities at STF are expected to be qualified and beneficial for teachers’ knowledge and skills improvement. One of which is an activity that can solve specific problems faced by them. Trainee’s characteristics, instructional satisfaction and organizational factors of perceived learning significantly influence the perceptions of trainees [14]. In Kirkpatrick’s program evaluation theory, teachers’ perceptions of training activities are included in the reaction level that raise several questions in order to find out participants’ interest and feeling about the training benefits after spending their time and effort [15]. The training program is effective if the training process satisfies participants for they are motivated to learn and practice [16]. Teachers’ motivation indicators consist of three attributes, namely: 1) suitability of the resource persons’ expertise with the activity material; 2) suitability of activity material with program objectives; 3) teachers’ motivation to participate in STF activities. Teacher motivation in the STF activities is also influenced by the institutional support.

Supervision and awarding for good achievement or performance are useful for teacher’s career development. Besides, it will be able to foster teacher’s motivation and commitment to continue to strive improving the quality in learning management to achieve the best student’s learning outcomes. The higher the awarding continuously given for employees, it will have an impact on increasing performance [17]. Rewards and recognition for the work accomplished by the leadership as motivation allows employees to continue working for the institution so that they are motivated to improve their performance [18]. Accordingly, if employees see the benefits of training and development programs such as incentives or promotions, they will be motivated and job satisfaction can be achieved, which in turn can lead to the increased performance and productivity [19]. Indicators of institutional support include two attributes, namely: 1) teacher’s supervision of STF activities; 2) an award/recognition of teacher’s performance.

2 Method

The research subjects were junior high school Mathematics teachers. The respondents are 83 teachers as participants in the STF from the population are 251 teachers. This research data collection technique used an instrument of a close questionnaire sheet with a Likert scale. The Likert scale consists of five points to measure the level of importance (1 = very unimportant to
5 = very important) and performance reality (1 = very dissatisfied to 5 = very satisfied) on each attribute. The questionnaire consisted of 25 attribute items identified based on five indicators of the Mathematics teacher professional development program at the STF. The instrument design before use was validated by using expert’s justification. Instruments that are already valid were then tested to see its reliability by using the application of SPSS version 20 with the Cronbach Alpha coefficient.

Data analysis determined the value (category) of the conformity level between the level of importance and the level of satisfaction with the attribute performance. The value of the conformity level is a comparison between the scores of performance and importance level presented in a percentage. Sukardi and Cholidis in Anggraini, Deoranto & Ikasari state that the criteria for the level of conformity between the level of importance and the level of satisfaction with performance are said to be good, if the percentage level of attribute conformity is at least equal to the average percentage and close to 100% of all attributes [20].

The research findings are presented in tables that include the description of the conformity level between perceived reality (performance) and what the teacher expects (level of importance) to the attributes of the teacher’s professional development program at STF. The value of this level of conformity will be used in determining priority handling of the factors that affect teacher’s satisfaction. The formula used to measure the level of conformity is as below:

\[
Tk = \frac{X}{Y} \times 100\%
\]

Tk = The level of conformity between the level of importance and performance attributes.
X = The score of teachers’ perceptions regarding performance attributes.
Y = The score of teachers’ expectations regarding the importance level of the attributes.

### 3 Results and Discussion

The average level of conformity between importance and performance program is 81%. This percentage is the criterion for determining the level of conformity of program attributes and indicators, as shown in table 1 as follows.

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Average of Importance</th>
<th>Average of Performance</th>
<th>Conformity Level</th>
<th>Criteria (&gt; 81%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Structure</td>
<td>4.23</td>
<td>3.50</td>
<td>83%</td>
<td>Good</td>
</tr>
<tr>
<td>Administrator’s Readiness</td>
<td>4.30</td>
<td>3.45</td>
<td>80%</td>
<td>Poor</td>
</tr>
<tr>
<td>Teachers’ Needs</td>
<td>4.16</td>
<td>3.46</td>
<td>83%</td>
<td>Good</td>
</tr>
<tr>
<td>Teachers’ Motivation</td>
<td>4.16</td>
<td>3.53</td>
<td>85%</td>
<td>Good</td>
</tr>
<tr>
<td>Institutional Support</td>
<td>4.23</td>
<td>3.21</td>
<td>76%</td>
<td>Poor</td>
</tr>
<tr>
<td>Average</td>
<td>4.21</td>
<td>3.43</td>
<td>81%</td>
<td></td>
</tr>
</tbody>
</table>

Table 1 above points out that none of the five indicators is 100% in accordance with the level of importance (expectations) of the teacher. However, there are three indicators whose conformity level is above average (> 81%) and close to 100% or relatively in line with
teacher’s expectations, namely program structure (83%), teachers’ needs (83%), and teachers’ motivation (85%). Meanwhile, indicators with a low level of conformity (below the average) are indicators of institutional support (76%) and administrator’s readiness (80%). This indicates that the expectations of Mathematics teachers regarding the teacher professional development program at STF, which are described in all the attributes of the five indicators, are generally still below the reality accepted by teachers. In other words, the performance attributes of the five indicators still do not meet conformity of 100% between the level of importance and performance.

4.1 The level of Conformity of Program Structure Indicator

In an effort to achieve the objectives of the junior high school mathematics teacher professional development program at the STF in Tangerang, learning activities and work practices are designed consisting of Information and Communication Technology (ICT) training activities, question writing workshops, Classroom Action Research (CAR) seminars, simulations of learning models, and workshops for making props. Furthermore, work practices comprise of the exam subject matter analysis based on Graduate Competency Standards (GCS), preparation of Final Semester Examination outlines, development of learning tools, utilization of multimedia, and making Olympic questions. The level of conformity of the program structure is shown in table 2 below.

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Average of Importance</th>
<th>Average of Performance</th>
<th>Conformity Level</th>
<th>Criteria (&gt; 81%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information and Communication Technology (ICT) Training Activities</td>
<td>4.23</td>
<td>3.60</td>
<td>85%</td>
<td>Good</td>
</tr>
<tr>
<td>Question Writing Workshops</td>
<td>4.23</td>
<td>3.58</td>
<td>85%</td>
<td>Good</td>
</tr>
<tr>
<td>Classroom Action Research (CAR) Seminars</td>
<td>4.18</td>
<td>3.40</td>
<td>81%</td>
<td>Good</td>
</tr>
<tr>
<td>Simulations of Learning Models</td>
<td>4.23</td>
<td>3.30</td>
<td>78%</td>
<td>Poor</td>
</tr>
<tr>
<td>Workshops for Making Props</td>
<td>4.33</td>
<td>3.53</td>
<td>82%</td>
<td>Good</td>
</tr>
<tr>
<td>Analysis of Exam Subject Matter</td>
<td>4.23</td>
<td>3.43</td>
<td>81%</td>
<td>Good</td>
</tr>
<tr>
<td>Analysis of Graduate Competency Standards (GCS) of National Exam</td>
<td>4.33</td>
<td>3.73</td>
<td>86%</td>
<td>Good</td>
</tr>
<tr>
<td>Preparation of Final Semester Examination Outlines</td>
<td>4.43</td>
<td>3.80</td>
<td>86%</td>
<td>Good</td>
</tr>
<tr>
<td>Development of Learning Tools</td>
<td>4.18</td>
<td>3.50</td>
<td>84%</td>
<td>Good</td>
</tr>
</tbody>
</table>
Utilization of Multimedia

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>Standard Deviation</th>
<th>Conformity Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making Olympic Questions (HOTS Level)</td>
<td>4.03</td>
<td>3.18</td>
<td>Poor</td>
</tr>
<tr>
<td></td>
<td>82%</td>
<td></td>
<td>Good</td>
</tr>
<tr>
<td>Average</td>
<td>4.23</td>
<td>3.50</td>
<td>83%</td>
</tr>
</tbody>
</table>

Table 2 shows the average of percentage level of program structure indicator conformity of 83%, this is higher than the average level of conformity of the overall attributes of the five program indicators, which is 81% (see table 1). This means that the level of performance of the attributes on the aspects of program objectives is generally in a good category or is in accordance with teacher’s expectations at the level of 83%.

Meanwhile, the attribute that has the lowest percentage level of conformity is the Simulation of Learning Models (78%) followed by the attribute of the Olympic question-making activity (79%). This shows that the level of performance of these two attributes is not in accordance with teachers’ expectations, so that in the future program administrator need to consider the resource factors. The attributes that have the highest percentage level of conformity are GCS analysis activity (86%) and preparation of Final Semester Examination (UAS) outlines (86%). These two attributes have a level of conformity above the average, so that it is good and relatively close to 100% conformity for the level of importance and performance.

Analysis of the research results on program structure indicators shows that the teacher considers the attributes contained in the program structure of the STF activities have a high level of importance (high importance). The assumption is that the teacher thinks that activity program can improve knowledge and develop skills. This is in line with the proposition of Tanang, Abu & Mukhtar on the importance of a teacher who has strong competence in subjects, pedagogical skills and an understanding about learning management, so that to improve students’ performance and contribute to strengthen teachers in implementing the entire curriculum [21].

The structure of the Mathematics teacher professional development program at the STF in Tangerang is achieved by collaborating between peer teachers and presenting expert resource persons, through experience sharing, trainings, workshops and seminars. Teacher’s professional development is influenced by positive school culture, cooperation between teachers and cooperation between teachers and external resource persons [22]. Although the level of importance and performance of the program structure attributes generally have a good level of conformity, it is necessary to improve the program for simulating learning models and making HOTS level questions.

### 4.2 The level of Conformity of Administrator’s Readiness Indicator

The administrator’s readiness for implementing junior high school Mathematics teachers’ professional development programs at STF in Tangerang includes attributes of the conformity of program and activity budgets, the availability of media/activity aids, the availability of activity materials/sources, the socialization of activity programs and the evaluation of previous activity programs. The level of conformity of the administrator’s readiness indicators is shown in the following table 3.
Table 3. Analysis of the Level of Conformity of Administrator’s Readiness Indicator

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Average of Importance</th>
<th>Average of Performance</th>
<th>Conformity Level</th>
<th>Criteria (&gt; 81%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Conformity of Program and Activity Budgets</td>
<td>4,28</td>
<td>3,43</td>
<td>80%</td>
<td>Poor</td>
</tr>
<tr>
<td>The Availability of Media/Activity Aids</td>
<td>4,40</td>
<td>3,05</td>
<td>69%</td>
<td>Poor</td>
</tr>
<tr>
<td>The Availability of Activity Materials/Sources</td>
<td>4,33</td>
<td>3,68</td>
<td>85%</td>
<td>Poor</td>
</tr>
<tr>
<td>The Socialization of Activity Programs</td>
<td>4,33</td>
<td>3,50</td>
<td>81%</td>
<td>Good</td>
</tr>
<tr>
<td>The Evaluation of Previous Activity Programs</td>
<td>4,18</td>
<td>3,58</td>
<td>86%</td>
<td>Good</td>
</tr>
<tr>
<td>Average</td>
<td>4,30</td>
<td>3,45</td>
<td>80%</td>
<td>Poor</td>
</tr>
</tbody>
</table>

Table 3 defines that the percentage level of conformity for the administrator’s readiness indicator is 80%, lower than the average percentage level of conformity for the overall program indicator attributes (80% < 81%) or in the poor category. This means that the level of performance of the attributes on the indicator of administrator’s readiness is relatively less in line with teacher’s expectations.

Meanwhile, the attribute that has the lowest percentage level of conformity is the availability of media/activity aids at the STF (69%) followed by the attributes of program conformity and activity budget. The percentage of these two attributes is less than 81% or is lower than the average percentage of the level of conformity of all program indicator attributes. This shows that the level of performance of these two attributes is not in line with the teachers’ expectations, so that in the future, program administrators need to consider factors of supporting resources in the form of media/tools and an adequate activity budget for improvement.

The attribute that has the highest percentage level of conformity is the evaluation of the previous activity program (86%) followed by the availability of materials/activity sources (85%). These two attributes have a level of conformity above the average, so it is good and relatively close to 100% between the level of importance and performance.

The analysis of the research results for STF administrator’s readiness indicator show that the attributes of administrator’s readiness are considered by teachers to have a high level of importance (high importance), but in general the performance attributes are considered low (low performance). This is due to the lack of availability of program support capacity, such as media/activity aids and conformity between programs and budgets. The lack of availability of the carrying capacity of this program does not meet the factor of program effectiveness.
The administrator’s role, teacher’s attitudes, training needs and strategies for conducting training are factors contributing to the effectiveness of in-service training [23]. Concerning to the low readiness performance of STF administrators, it is necessary to increase the provision of training needs, especially for media/tools and appropriate activity budgets.

To become professionals, teachers should be equipped by policies support, morals, infrastructures, and funds [24]. In the policy context, the government needs to make policies on school performance standards in relation to community-based teacher professional development. Thus, the principal and officials of the Education Office will have a real interest in improving teacher’s professionalism, thus encouraging good cooperation for the management of STF activities. Good cooperation related to time management, administration, budget, facilities and strategies in carrying out activities.

4.3 The level of Conformity of Teachers’ Needs Indicator

The indicator of teachers’ needs in implementing junior high school Mathematics teacher’s professional development programs at STF in Tangerang include the attributes of activity materials that can improve knowledge, training that can improve skills, activities that can increase creativity, and the suitability of activity materials with teachers’ needs. The level of conformity of the teachers’ needs indicator is described in table 4 below.

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Average of Importance</th>
<th>Average of Performance</th>
<th>Conformity Level</th>
<th>Criteria ($&gt; 81%$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity Materials That Can Improve Knowledge</td>
<td>4.08</td>
<td>3.65</td>
<td>90%</td>
<td>Good</td>
</tr>
<tr>
<td>Training That Can Improve Skills</td>
<td>4.15</td>
<td>3.40</td>
<td>82%</td>
<td>Good</td>
</tr>
<tr>
<td>Activities That Can Increase Creativity</td>
<td>4.20</td>
<td>3.25</td>
<td>77%</td>
<td>Poor</td>
</tr>
<tr>
<td>The Suitability Of Activity Materials With Teachers’ Needs</td>
<td>4.20</td>
<td>3.53</td>
<td>84%</td>
<td>Good</td>
</tr>
<tr>
<td>Average</td>
<td>4.16</td>
<td>3.46</td>
<td>83%</td>
<td>Good</td>
</tr>
</tbody>
</table>

Table 4 presents the percentage level of conformity for the indicator of teachers’ needs is 83\%, higher than the percentage of the average level of conformity of the overall program indicator attributes (83\% $> 81\%$). This means that teachers’ perceptions of the performance of the attributes for the indicator of teachers’ needs are in line with teachers’ expectations at the level of 83\%.

Meanwhile, the attribute that has the lowest percentage level of conformity and is below the average is the existence of activities that can increase creativity (77\%) or less in line with teachers’ expectations. While the attribute that has the highest percentage level of conformity, above the average and close to 100\%, is the activity material that can improve knowledge (90\%). The performance of this attribute is already in line with the level of importance at the level of 90\%.
Analysis of the research results on teachers’ needs indicator, when viewed from the level of conformity between the level of importance and performance of the attributes of teachers’ needs in general is in the good category. However, on the other hand, the performance of the program implementation activities is considered to be still not encouraging creativity. In this case, it is necessary to innovate activity models in order to provide inspiration to encourage creativity. So that not only the activity material meets the teachers’ needs, but also for the performance of the activity. The STF activity model needs innovation in order to encourage teacher’s creativity to answer the real challenges faced in managing the learning.

The performance of teacher’s professional development program activities that cannot meet their needs is not in line with Strong’s statement cited by Sutopo, that developing teacher professionalism must be based on the real teachers’ needs in doing their work [25]. Therefore, in planning the next program activities, STF administrators need to conduct a preliminary survey on real problems related to learning activities faced by teachers.

4.4 The level of Conformity of Teachers’ Motivation Indicator

The indicator of teachers’ motivation in implementing junior high school Mathematics teacher professional development programs at STF in Tangerang comprises attributes of the conformity of resource persons’ expertise with activity material, the conformity of activity material with program objectives and the existence of teachers’ motivation to participate in STF activities. The level of conformity of the teachers’ motivation indicator is described in table 5 as follow.

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Average of Importance</th>
<th>Average of Performance</th>
<th>Conformity Level</th>
<th>Criteria (&gt; 81%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Conformity of Resource Persons’ Expertise with Activity Material</td>
<td>4.28</td>
<td>3.75</td>
<td>88%</td>
<td>Good</td>
</tr>
<tr>
<td>The Conformity of Activity Material with Program Objectives</td>
<td>4.08</td>
<td>3.53</td>
<td>87%</td>
<td>Good</td>
</tr>
<tr>
<td>The Teachers’ Motivation To Participate in STF Activities</td>
<td>4.13</td>
<td>3.33</td>
<td>81%</td>
<td>Good</td>
</tr>
<tr>
<td>Average</td>
<td>4.16</td>
<td>3.53</td>
<td>85%</td>
<td>Good</td>
</tr>
</tbody>
</table>

Table 5 informs the percentage level of conformity of the teachers’ motivation indicator is 85%, higher than the average percentage of the overall conformity level of the attributes of the five program indicators (85% > 81%) and close to 100%. This means that teachers’ perceptions of the performance of the attributes of the motivational indicators are in line with teachers’ expectations at the level of 85%.

Meanwhile, the attribute that has the lowest percentage level of conformity is the teachers’ motivation to participate in STF activities (81%), but it is still in the good category. The
percentage level of the conformity of this attribute has a very small difference in numbers with the criteria. This means that the performance of teachers’ motivation indicator attributes is still in line with the level of program importance or in accordance with teachers’ expectations. Meanwhile, the attribute that has the highest percentage level of conformity is the conformity of the resource persons’ expertise with the activity material (88%). Therefore, the suitability of the resource persons with the activity material is considered in accordance with the teachers’ expectations at a high level.

Analysis of the research results on teachers’ motivation indicator is in the good category, this shows that the teachers assess the teacher’s professional development program at the STF as beneficial for them. There is conformity between the resource persons’ expertise with activity materials and activity materials with program objectives. Thus, they have high motivation in participating in the STF activities. This condition is in line with Luong’s proposition which can be interpreted, that from the reactions of the trainees it can be seen whether they like participating in the training and whether they feel they have benefited after spending their time and efforts [26].

In general, the level of conformity between the importance and the performance of the attributes of the teachers’ motivation indicator is good. The conformity of the resource persons’ expertise with the activity material was assessed by the teacher as good. Therefore, good performance as an indicator of teachers’ motivation needs to be maintained in the implementation of further STF activity program.

4.5 The level of Conformity of Institutional Support Indicator

The indicator of institutional support for the implementation of the junior high school Mathematics teacher’s professional development program at STF in Tangerang consists of the attributes of the teacher’s supervision in STF activities and the existence of rewards/recognition of teacher’s performance. The level of conformity of the institutional support indicator can be seen in table 6 below.

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Average of Importance</th>
<th>Average of Performance</th>
<th>Conformity Level</th>
<th>Criteria (≥ 81%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Teacher's Supervision in MGMP Activities</td>
<td>4,05</td>
<td>3,38</td>
<td>83%</td>
<td>Good</td>
</tr>
<tr>
<td>The Existence of Rewards/Recognition of Teacher’s Performance</td>
<td>4,40</td>
<td>3,05</td>
<td>69%</td>
<td>Poor</td>
</tr>
<tr>
<td>Average</td>
<td>4,23</td>
<td>3,21</td>
<td>76%</td>
<td>Poor</td>
</tr>
</tbody>
</table>

Table 6 points out that the attribute that is relatively in line with teachers’ expectations is the teachers’ supervision in STF activities with a percentage of 83%. The level of conformity of this attribute is higher than the average percentage of the level of conformity of all program indicators (83% > 81%). While one other attribute, namely the existence of rewards/recognition of teacher’s performance with a conformity level of 69% indicates that it is not in line with teachers’ expectations. The percentage of the conformity level of this attribute is lower than the average percentage of the level of conformity of all program indicators (69% < 81%).
While in general, the percentage level of conformity for the institutional support indicator is 76%, this is lower than the average percentage level of conformity for the overall program indicators (76% < 81%). The low level of conformity between the level of importance and the performance of the institutional support indicator is caused by the low rewards or recognition of school institutions for teachers’ performance.

The analysis of research results that shows the low support from school institutions concerning to rewards or recognition of teachers’ performance in STF activities needs serious attention from interested parties. In this case, the Principal and School Supervisors need to increase their support not only for supervision, but also giving awards or recognition to teachers’ performance. As the results of research conducted by Prabu & Wijayanti, the higher the continuous awarding of employees will have an impact on increasing performance [27]. Likewise, the research results of Wahab, Hussain, Zadeh & Shah, that giving incentives or promotions will motivate employees, so that job satisfaction can be achieved, which in turn can lead to the increased performance and productivity [28].

Rewards or recognition of good teacher’s performance needs to be as a main priority for STF administrators for improvement in the implementation of teacher’s professional development programs at the next STF. STF administrators need to collaborate effectively with interested parties on teachers’ performance.

5 Conclusion

Conclusively, the research results point out that the level of conformity between the level of importance and performance of the teachers’ professional development program at STF is generally in the good category and is beneficial for teachers and school institutions. The level of conformity between the level of importance and program performance viewed from the program structure of the STF is generally in the good category, tends to be effective, in line with the concept to strengthen subject competence, pedagogic skills, and teachers’ understanding of learning management. While viewed from the readiness of the STF administrators is generally in the poor category. This includes the conformity of providing budget and program, media/tools and materials/sources for learning activities, as well as conducting program socialization and evaluation of previous programs. Therefore, it is necessary to improve the readiness in managing the development of STF activity programs in order to encourage the active role of teachers in order to achieve the effectiveness of the activities implementation.

The level of conformity between the level of importance and program performance in terms of the perspective of teachers’ needs is generally in the good category. However, it has not been able to increase creativity to answer current learning problems faced by teachers. Therefore, STF administrators need to improve the planning of activity programs by identifying and considering projections of activity material that are needed by teachers, to accommodate previous teachers’ experiences, both in terms of knowledge and skills, so that teachers can be more creative and innovative. Likewise with respect to teachers’ motivation is generally in the good category, has meaning (value) for improving work professionalism as a teacher. Teachers like, feel happy and feel that they benefit from these activities so that motivation arises in the teacher to be actively involved.

While the level of conformity between the level of importance and program performance of the perspective on institutional support (schools) is generally in the poor category. The effectiveness of the principal’s involvement needs to be improved, such as supervision, the ease with which teachers participate in STF activities, and rewards or recognition of teachers’
performance in the STF activity process and after teachers return to work at school. The ineffective support of this school institution can be suspected as the cause of some schools whose teachers do not actively participate in the STF activities. For this problem, further research is needed.

References


Green Synthesis of Porous Fe$_2$O$_3$/Au Nanocomposite with Chitosan Template using *Gliricidia Sepium* Leaf Aqueous Extract and its Catalytic Activity for the Reduction of 4 Nitrophenols

Purnomo Arif Abdillah$^1$, Yoki Yulizar$^2$

{purnomo.arif@ui.ac.id$^1$, yokiy@sci.ui.ac.id$^2$}

Department of Chemistry, Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Indonesia. Kampus UI Depok, Depok 16424, Indonesia

Abstract. In this work, the green synthesis of porous Fe$_2$O$_3$/Au nanocomposite was carried out by reacting Fe(NO$_3$)$_3$ with *Gliricidia sepium* leaf aqueous extract and chitosan template using the sol-gel method. After the gel formation, the samples were calcined at 700°C and modified with AuNP. The synthesized porous Fe$_2$O$_3$/Au nanocomposites were characterized using UV-Vis Spectrophotometer, Fourier Transformation Infrared Spectroscopy (FTIR), X-ray diffraction spectroscopy (XRD), and Scanning electron microscope (SEM). Porous Fe$_2$O$_3$/Au nanocomposite was tested for catalytic activity for the reduction reaction model of 4-nitrophenol with NaBH$_4$. The catalytic activities of the porous Fe$_2$O$_3$/Au nanocomposite in reactions were monitored by using UV-Vis spectroscopy. The XRD and FTIR confirm the compound formed is α-Fe$_2$O$_3$. It was found that the porous Fe$_2$O$_3$/Au can convert up to 79% 4-nitrophenol to 4-aminophenols.

Keywords: Porous Fe$_2$O$_3$/Au, Green Synthesis, *Gliricidia sepium* leaf Extract, 4 nitrophenol reduction catalyst

1 Introduction

Recent study [1] shows that porous nanocomposite have better properties than non-porous nanoparticles. With the presence of holes in the particles, it will increase the surface area, thereby increasing the ability of the catalyst properties for 4-nitrophenol reduction [2], increasing the electrode capability of the battery [3], increasing battery capacity[4], and increase the nature of the catalyst and the photo thermal effect [5]. The synthesis of porous nanoparticles was carried out using a template in the form of polysaccharides. In previous research, Mg-doped ZrO$_2$ nanoparticles had been synthesized using aloe vera extract templates. The template is a polysaccharide molecule in the aloe vera extract so that the zircon nitrate salt precursor sticks to the polysaccharide surface and forms a ball. Polysaccharide molecules are removed by calcination [6]. Chitosan is a linear polysaccharide composed of β 1-4 bonds, which are randomly bound to D glucosamine and N acetyl glucosamine, and can cross-link to produce molecules of certain sizes. Chitosan can be used as a template for the synthesis of Fe$_2$O$_3$ nanoparticles using the hydrothermal method. The results obtained were that the particles were more homogeneous and the chitosan template was removed by calcination [7].

Green synthesis method is starting to be commonly used in the synthesis of nanocomposite. The use of natural ingredients or biomasses such as plant extracts, algae and fungi has been used for nanosynthesis [8]. *Gliricidia sepium* (Gamal plant) is a shrub from a
legume relative. Often used as a living fence or shade, this shrub or small tree is growing in many areas of Indonesia. Its leaves contain saponins, alkaloids, and flavonoids [9], which are needed for the green synthesis process of nanoparticles. Previous research used Gliricidia sepium leaf extract for AgNP synthesis [10] for anti-bacterial applications.

To assess the catalytic properties of the nanocomposite, the reduction of 4-nitrophenol is chosen as the model reaction. 4-nitrophenol is a colourless to yellowish odourless crystal, having the molecular formula C₆H₅NO₃ with a molecular weight of 139.11 g/mol. 4-nitrophenol is a pollutant as a result of waste from the pesticide, pharmaceutical, dye and petroleum industries. 4-nitrophenol is a dangerous pollutant because it is stable in water and harmful to health and the environment[11]. Based on the toxicological studies conducted, 4-nitrophenol can cause blood and kidney disorders, liver damage and eye irritation[12]. Catalytic reduction of 4-nitrophenol with NaBH₄ as a reducing agent and will produce the final product in the form of a 4-aminophenol that much less toxic.

In this study, porous Fe₂O₃/Au nanocomposite were synthesized with chitosan templates using the sol-gel method in green synthesis using Gliricidia sepium leaf extract as a reduction and capping agent. The activity of the synthesized porous Fe₂O₃/Au nanocomposite was tested for the hydrogenation reaction of 4-nitrophenol and compared with the non-porous Fe₂O₃/Au nanocomposite.

2 Method

2.1. Materials
Gliricidia sepium leaf. (GSL) was obtained from Secang district, Magelang, Indonesia. Chitosan was obtained from PT ChiMultiguna. Methanol, n-hexane, were obtained from PT. Brataco. HAuCl₄ used in this research was synthesized by dissolving 99.9% Au metal from PT. Antam in aqua regia solvent with HNO₃ and HCl ratio of 1:3. HNO₃, HCl and Fe(NO₃)₃.9H₂O were obtained from Merck. All chemicals were analytical grade and used without further purification.

2.2. Preparation of Gliricidia sepium Leaf. (GSL) Extract
About 2 kg of GSL dried in room temperature for one week. The dried leaves were blended to soft powders, GSL powder was macerated in methanol with 1:6 ratio w/v for six days, and mixed constantly. The macerated GSL was filtered and the filtrate was extracted using n-hexane in a separation funnel until it formed two fractions. The separated water fraction was phytochemicals analyzed for its polyphenol, tannin, alkaloid, flavanoid, saponin, terpenoid, and steroid contents. The water fraction was saturated using vacuum rotary evaporator to remove its water solvent and characterized using FTIR spectroscopy (Shimadzu Prestige 21). The saturated GSL extract was then made into a stock solution with 6% concentration (w/v).

2.3. Preparation colloidal chitosan
Colloidal chitosan was prepared by reacting 3 grams of chitosan powder with one liter of 1% acetic acid solution. The solution then stirred and placed in sonicator in 50°C for 3 hours. The results of the reaction were characterized with Particle Size Analyzer to confirm that colloidal chitosan was formed.
2.4. Synthesis of Fe₂O₃/Au nanoparticles

The synthesis of Fe₂O₃/Au nanoparticles (Fe₂O₃/Au-NP) was carried out by mixing the water fraction of GSL extract into the precursor solution of Fe(NO₃)₃ 0.01 M. The mixture was stirred for 2 hours at a temperature of 80-100°C until solution turns dark brown. The colloidal solution formed is heated for 10 hours at 120°C to evaporate the water. The mixture then calcined at 700°C for 5 hours to obtain Fe₂O₃ nanoparticle powder. 40 mg of Fe₂O₃ nanoparticle powder then dispersed in 98ml of distilled water, and 1ml of 1 x 10⁻³ M HAuCl₄ solution was added slowly. The solution was added with 1 ml of GSL extract with continued stirring for 2 hours. The mixture dried at 120°C. After drying, the gel formed was rinsed with distilled water and calcined to remove the remaining organic material from GSL Extract.

2.5. Synthesis of porous Fe₂O₃/Au

Colloidal chitosan solution was added with the precursor solution of Fe(NO₃)₃ 0.01 M. The solution was stirred for 2 hours at room temperature. The solution was added with 1 mL of GSL extract and heated at a temperature of 80-100°C until solution turns dark brown. Fe(OH)₃-chitosan which is formed is dried at 10 hours at 120°C to evaporate the water. The mixture then calcined at 700°C for 5 hours to obtain porous Fe₂O₃ powder. 40 mg of porous Fe₂O₃ powder then modified with AuNP with the same method above.

2.6. Catalytic activity

4-nitrophenol reduction was used as a model to test the catalytic activity of the synthesized nanocomposites. The catalyst performance test was carried out with mixing 5 mg of catalyst and 10 mL solutions containing 5 x 10⁻⁵ M 4-nitrophenol and 0.1 M NaBH₄. The solutions immediately transferred to cuvette and recorded it absorption using a UV-Vis spectrophotometer (Shimadzu 2600 series) at wavelength 250 – 550 nm as a function of time.

3 Results and Discussion

3.1 Characterization of GSL Extract

Identification of GSL extract was firstly done by phytochemical test. It is conducted to qualitatively analyze the presence of secondary metabolites in aqueous GSL extract. The result showed that aqueous GSL extract contains flavanoids, alicaloids, polyphenols and saponins. Analysis of functional groups of compound contained in the water fraction GSL using a FTIR spectrophotometer is shown in Figure 1. The GSL FTIR spectrum shows a band at 3354cm⁻¹, due to stretching vibrations of the hydroxyl functional group (-OH) originating from alcohol or phenol, peak at 2933cm⁻¹ by stretching vibrations of the functional group CH sp², peak at 1656cm⁻¹ and 1593cm⁻¹ shows stretching vibrations of the C=O and CC aromatic groups, peak at 1403cm⁻¹ by the stretching vibrations of the CH group of alkanes and peak at 1072cm⁻¹ by the stretching vibrations of the CO groups which derived from esters or glycosides. There is peak in 1035cm⁻¹ from C-N amine stretch. The results of GSL extract FTIR characterization are comparable with previous studies [13].
Based on the results, it is known that there are several functional groups in GSL water fraction using FTIR, indicating the presence of secondary metabolites. Identification of saponin compounds is known by the presence of functional groups OH, CH, C = C and CO glycosides [14] while the presence of Alkaloid compounds comes from the presence of CN and C=C groups [15].

3.2 Characterization of Fe2O3/Au

FTIR measurements were carried out to determine which functional groups contained in secondary metabolites of GSL extract that play a role in the formation process of Fe2O3. The results of the FTIR Fe2O3 spectra are shown in Figure 2. In the interaction between GSL extract and Fe-OH, there is a widening and shifting of the peaks of –OH. This shows the interaction of the -OH group from the GSL extract with Fe(OH)3. This shows that the –OH group acts as a capping agent in the synthesis of Fe2O3 NP. Before calcination, Fe(OH)3 did not have double absorption at around 551 and 467 cm⁻¹, which indicates that Fe3O4 has not been formed.
The characteristics of Fe-O appeared at 467 cm\(^{-1}\) and 551 cm\(^{-1}\). The spectra at high frequency (551 cm\(^{-1}\)) is associated with Fe-O deformation at the octahedral and tetrahedral sites, while at lower frequencies (467 cm\(^{-1}\)) it is derived from Fe-O deformation at the octahedral site of hematite[16]. The different shape of Fe\(_2\)O\(_3\) will cause a slight shift in this peak [17]. The wide peak in the Fe\(_2\)O\(_3\) spectra around 3300 cm\(^{-1}\) is the O-H stretching vibration. The peak at 1565 cm\(^{-1}\) is the absorption of water molecules present in Fe\(_2\)O\(_3\) [18]. From the Fe\(_2\)O\(_3\) spectra that has been calcined, it can be seen that almost all of the organic material from the GSL has been lost.

The FTIR spectra of porous and nanoparticle Fe\(_2\)O\(_3\) modified with AuNP are similar without AuNP (Figure 3 and Figure 4). The absorption at 467 and 551 cm\(^{-1}\) still derived from Fe-O vibrations. The spectral similarity of the AuNP-modified catalysts is the same as the support, indicating that the addition of AuNP has no or little effect on the hematite bonding. The hole in the porous Fe\(_2\)O\(_3\) in other way, make some impurities in the porous Fe\(_2\)O\(_3\)/Au resulting in the noisier FTIR spectra.

![Fig 3. FTIR Porous Fe\(_2\)O\(_3\) Porous and Fe\(_2\)O\(_3\) NP comparison](image)

![Fig 4. FTIR Porous Fe\(_2\)O\(_3\) and Porous Fe\(_2\)O\(_3\)/Au comparison](image)
Figure 5 above shows the XRD pattern of the calcined iron oxide powder. All diffraction peaks are in accordance with the α-Fe₂O₃ JCPDS card no. 89-596, indicating that the compound formed is α-Fe₂O₃ [16]. Analysis of the average Fe₂O₃ crystal size is calculated by the Debye-Scherer equation,

$$D = \frac{K\lambda}{\beta \cos \theta},$$

(1)

Where D is the crystal size, with a K value of 0.9 and a wavelength (Cu) of 1.542 Å, the crystal size of Fe₂O₃ is 62nm. In the porous Fe₂O₃-AuNP composite, the peak intensity of AuNP was weak, because the Au concentration was only 5%. The only significant peak is at an angle of 2θ 38.26° which is the 111 hkl plane of the AuNP crystal. There is no new peak in the Fe₂O₃/Au, meaning that no chemical bond exist between Au and Fe₂O₃ molecule. This result conform to FTIR data.
Figure 6 shows the image of porous Fe$_2$O$_3$ - AuNP composite. The bright area of the image are the AuNP’s. AuNP are scattered evenly on the surface of porous Fe$_2$O$_3$. This immobilized the AuNP in the solution. The size of AuNP obtained ranging between 60 to 200nm.

3.3 Catalytic activity of Fe$_2$O$_3$/Au

The reduction reaction of 4 nitrophenols using NaBH$_4$ can be observed using UV-Vis spectroscopy (Figure 7). 4-nitrophenol will change to 4-nitrophenolate ion in alkaline conditions and has a strong absorption at 400nm, the product of this reaction is 4 aminophenol which has a weaker absorption at 300nm. By observing the absorbance of 4 nitrophenolates ion at 400nm, the 4-nitrophenol concentration can be obtained in real time. The percent of 4-nitrophenolate ion that consumed in reaction then plotted with time in Figure 8.

From the results of the reduction reaction NaBH$_4$ shows that the effectiveness as a reduction catalyst increases with the presence of holes in the material. Having holes increases the surface area which is important for increasing contact with the subtrat. Within 60 minutes, it showed that 4 nitrophenols were converted by Fe$_2$O$_3$ NP, porous Fe$_2$O$_3$, Fe$_2$O$_3$/Au NP, porous Fe$_2$O$_3$/Au at 5.5, 7.5, 70 and 79% respectively (Table 1) This figure is still below the AuNP as a reference, because AuNP is a homogeneous catalyst that is evenly distributed in the solution. In addition, the immobilization of AuNP into Fe$_2$O$_3$ causes the catalyst to be heterogeneous and reusable.

![Fig 7. UV spectra of reduction 4NP in 60 minutes](image-url)
4 Conclusion

Porous Fe$_2$O$_3$/Au was successfully synthesized using *Gliricidia sepium* leaf extract and chitosan template using simple and green methods. *Gliricidia sepium* leaf extract contain saponins and flavonoids that act as capping agents to prevent agglomeration of nanoparticles. FTIR and XRD analysis confirmed the formation of $\alpha$-Fe$_2$O$_3$, and the addition of the AuNP doesn’t intervene with Fe$_2$O$_3$ structure. SEM analysis confirms the presence of AuNP in the surface of Fe$_2$O$_3$. From the results of the reduction reaction analysis, the presence of the holes in the porous Fe$_2$O$_3$/Au increases its effectiveness as a catalyst in 4-nitrophenol reduction with conversion rate of up to 79%.

Acknowledgements. This work is supported by Saintek scholarship given to the first author from Ministry of Research, Technology, and Higher Education, Indonesia

Reference


Digital Literacy of Students Using R Language

Rahma Wahyu¹, Sinollah²
{rahmawahyu7@gmail.com}

Universitas Islam Raden Rahmat, Jl. Raya Morjosari 2, Malang, Indonesia

Abstract. This study aims to develop an integrated management statistics textbook with R language to improve the digital literacy of students. Managements Statistics getting to know primarily based totally on ICT required to enhance it. Using packages is a high-quality manner to recognize all statistical concepts. One of the packages that may be used is the R language. R is the software that may help process information, offer information in graphical form, and study information. Design research approach followed on this study. The textbook evolved with Plomp model and referred to Tessmer formative evaluation. The subject is the management students who took statistics subject. The findings display that the textbook is valid, practice, and effective from the content and construct aspects. The acquisition during this study, improving digital literacy using R language is 75% categorized.

Keywords: Managements Statistics, digital literacy, R language

1 Introduction

Statistics is a department of technology wished in each day lifestyles and so that people can't be separated from the usage of records itself. Statistics become the focus in mathematics education reformation as a critical factor of everyday lifestyles [1]. Statistics is a branch of mathematics that analyzes data collection, processing the data, analyzing the data, and making conclusions based on findings [2]. Statistics has a critical position in accomplishing studies and statistics processing correctly. Therefore, records wish to be mastered properly with the aid of using university students. Students are anticipated to recognize entire records through the Management Statistics class, describe the statistics, examine the statistics, and make conclusions.

Moreover, statistical evaluation is becoming common in training, economics, biology, et al.. Because the need for statistics collection will increase, students are anticipated to enhance their potential to apply for the software program to process, present, and read statistics in graphical form. Nowadays, many software or programs have been developed that can help us in processing, presenting, and analyzing data in graphic form. Among the available software, some of them are free and paid software.
R is a free version of S language from a kind of paid software, namely S-PLUS [4]. R has entire and dependable functions that could help us process, present, and read statistics in the graphical form [5]. Furthermore, moral and legal responsibility factors are no longer becoming a concern in using R because they can be obtained freely. There are several reasons why R is used, including R is a language programming, so there are no restrictions for users to use procedures that can only be found in standard packages [5].

Analyzing data requires interactive operations. R is equipped with connectivity to the server database, and R is almost entirely compatible with the S-Plus [4]. Most of the code created by S can be run in S-Plus except for the add-on packages functions or addition created by R project contributors. R is the most popular language programming used by researchers in the field of statistics. Several articles in the journal of statistics have proved this thing. R is likewise famous for quantitative utility inside the finance field. Students are predicted so that it will recognize the material in the Management Statistics subject completely. Their understandings are obtained from their independent study without expecting their lecturers to transfer all of the materials. This is caused by the lecturing process in colleges requires an independent effort from students so that the learning process will not be boring. However, there are still many students get the low score in statistics subject in UNIRA Malang. The percentage of students who score less than 65 (categories C, D, and E) is 73%. This situation is still far from being expected.

The use of statistics has been applied in all sciences, but students' mastery has not been pleased, as explained [6]. Learning statistics are still taught traditionally, and transferring knowledge is still the mainstay method. Furthermore, learning knowledge should be connected to real life and explained its application [6]. Another case that often arises in Management Statistics lectures is the textbooks are still in translation version. It made the students feel not interested in learning the subject so that their ability to use their thinking skills to solve management statistics problems is low.

When viewed from the use of learning media, software in statistics subject in UNIRA Malang has not been implemented, even though there is much software such as R language. Using R language as Interactive learning media using ICT does have a significant contribution to learning among students and can support interactions with other people [3, 7-8]. R's utilization of functions and packages will create an animation program to demonstrate a theoretical theory [9, 10]. With a suitable preference of media or gaining knowledge of resources, it may affect students' capacity to have interaction in gaining knowledge via interplay with the media [9]. So expect, using R language can improve digital literacy and benefit students looking to develop computer skills for their careers [11]. Digital literacy is one of the six basic literacy, which is applied, especially in learning activities. Digital literacy can be grown by using the software in learning. Based on the description above, it is necessary to develop a Management Statistics textbook accompanied by R software for students taking statistics subject in UNIRA Malang. The development of textbooks using R language is expected to improve the digital literacy of the students.

2 Method

The development approaches in this study use a model of design research [10] which includes three stages of preliminary research, prototyping phase, and assessment phase. In the Preliminary research phase, conducted problem and need analysis and literature study. The
prototyping segment is creating a prototype. Assessment segment is the level of assessing whether or not the person can use a textbook (practicality) and wish to apply them and to assess the effectiveness of textbooks. Evaluation strategies used on this examine is a formative assessment that befell in all of the stages and the improvement cycle. The formative evaluation has numerous layers [11], as illustrated in Figure 1.

![Flowchart of the evaluation process.](image)

Figure 1 illustrates a number of the formative assessment techniques generally used. In this study, the formative assessment used is as follow: 1) Expert review. At this stage, the professional organization (a professional within side the area of study, professional educational layout) gives an evaluation and recommendation on the goods advanced; 2) Self-assessment is performed to apply checklists the crucial traits or layout specifications; 3) Evaluation of one-to-one (finished through customers who're consultant of instructors or college students); 4) Small organization or micro-assessment: related to small companies of college students through the use of the product in everyday situation. At this stage, the evaluator discovered and interviewed the respondents. Field take a look at changed into additionally finished to peer the effectiveness interactive textbook advanced and to get statistics to in addition enhancements to textbook advanced. The effectiveness of information accrued in pretest ratings and post-test a look at of college students. To see digital literacy skills, a questionnaire is used, the indicators of the questionnaire can be seen in table 1.

<table>
<thead>
<tr>
<th>No.</th>
<th>Item Indicator</th>
<th>Item Question</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Benefit of technology</td>
<td>1,2,3,4,5,6</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Using software</td>
<td>7,8,9,10,11,12,13,14,15,16,17,18</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Social networking</td>
<td>19,20,21,22</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Using learning media</td>
<td>23,24,25,26</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Online Safety</td>
<td>27,28</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Utilization digital literacy in learning</td>
<td>29,30</td>
<td>2</td>
</tr>
</tbody>
</table>
3 Result and Discussion

3.1 Preliminary Phase

Data of preliminary phase consequences acquired thru interviews with lecturer and students, syllabus document collection and learning implementation plan and statistics textbooks. Data acquired from the preliminary research namely interviews with the lecturer and students, and analyze the syllabus.

In the preliminary phase, showed that the responses acquired from lecturer do not forget that there need to be improvements in studying that enchantment to students in order that studying goals may be achieved. The responses acquired from the pattern students are interested by using ICT in studying. Student expectancies within side the utility of ICT isn't simplest constrained to using energy factor as a media presentation through the trainer however can get an exciting studying revel in and observe the improvement of technological know-how and technology. Experience in the usage of mathematical software program in studying records has by no means been acquired through lecturer. Implementation of ICT has ever accomplished simplest constrained to using energy factor as a media presentation. The use of this media is taken into consideration now no longer a lot help, in any other case even complicate the scholars in expertise the idea and the manner of calculation.

The second data from the preliminary research namely analyze the syllabus. The syllabus analyzed is the statistics syllabus. Based at the re-evaluation of the Statistics syllabus, the evolved textbook is designed textual content books that may be utilized in studying records for management.

3.2 Prototyping Phase

Developed prototype textbooks based on structures that have been designed. The activities for define step carried out at this stage are below: 1) Analyzing semester lesson plan (RPS), the purpose of this activity is to develop materials in the textbook with R software in accordance with Learning Outcomes (CP) that must be achieved by students; 2) Analyzing Management Statistics textbook, to see the suitability of content in the textbook with the basic and standards competency that students must achieve; 3) Reviewing literatures related to the development of textbook, to see references for the textbooks; 4) Conducting interviews with lecturers and students, this aims to find out what problems or obstacles are faced in the field in relation with Management Statistics lecturing.

Based on the step above, the textbook is compiled which consists of four chapters which can be used for one semester, the parts are: 1) Basic concept of statistics; 2) Showing the data; 3) Descriptions; 4) Opportunity Theory. Each chapter contains a description of the material, sample of questions, exercises, and assignments. Each chapter consists of several learning activities that had been adjusted with syllabus. The structure that will be developed is as follows.
The prototype of included R language in Management Statistics is primarily based totally systems which have been designed. Prototyping section is carried out following the formative assessment level evolved through Tessmer, this is making merchandise primarily based totally the consequences of the initial section analysis. Development is carried out through designing troubles and software program suitable to resolve the hassle presented. Software used is R language. The example of the textbook and textbook integrated R language can be seen in Figure 3.
An expert review was conducted to evaluate the revised text book according to the results of self-evaluation. Results Validation by the lecturers for all aspects can be seen Table 2.

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material/content</td>
<td>85.6%</td>
</tr>
<tr>
<td>Presentation</td>
<td>80.7%</td>
</tr>
<tr>
<td>Linguistics</td>
<td>79.4%</td>
</tr>
<tr>
<td>Graphic</td>
<td>81.3%</td>
</tr>
<tr>
<td>Total</td>
<td>81.75%</td>
</tr>
</tbody>
</table>

The four lectures' validation results indicated that the validity of statistics textbook in the criteria developed is very valid. The results of validation from the lectures as a whole is 81.75% by Muslich's opinion [12], which states that the textbook that has the content material feasibility is that if there's conformity of the cloth with the primary competence and competence supporters, material accuracy, and gaining knowledge of aid materials. The high-satisfactory of the textbook relies upon on its usefulness for gaining knowledge of functions university scholar. The extra wishes that may be served, the higher the book teach. For teachers, it presents possibilities for university students to examine in step with their very own speed; to do deepening; to make a revision and reflection; or document crucial matters for different functions.

Quality textbooks consequently now no longer handiest lie withinside the layout of the the book itself, however additionally on its usefulness. Good textbooks aren't only a series of ideas, however, programmed and systemic designs to paintings useful, concise but meaningful [13].
The end result of the textbook validation is visible from the content material, construct, linguistics, and image validity of the four components the assessed, acquired through class is pretty valid. It concluded that the version of era integration is needed for a powerful gaining knowledge of process [14]. Moreover, ICT helped students collect a closer knowledge of understanding material and enhance university students' achievement [15-17].

A follow-up of digital literacy to the R language is given to understand the result of university students' responses. It changed into acquired from the reactions of scholar questionnaires. The effects of the purchase of scholar responses withinside the use of textbooks with R language attain digital literacy responses, displaying a mean percent rating of 71.11%. Achievement to hone digital literacy the usage of categorized educational media is especially on components of the advantage of the era, the usage of software, social networking, the usage of gaining knowledge of media, on-line Safety, usage of digital literacy in gaining knowledge of. In digital literacy, customers speedy make frameworks on present or proposed packages or different academic measures [18].

4 Conclusion

Related to the findings and evaluation of data, it can be concluded that textual content book for data challenge blanketed withinside the standards very valid. Learning included R language may be carried out as early as viable to equip digital literacy because it's far one of the 21-century abilities that should be owned through the contemporary learner. Integrated R language has been proven to positively impact university students' motivation and interest, which frequently consequences in elevated part and progressed behavior, even though it can't enhance mastering effects automatically [19-20].

Acknowledgments. The research team partner: Dr. M. Andy Rudhito & Dr. rer. Nat. Herry Pribawanto Suryawan (FKIP-Universitas Sanata Dharma), DP2M Dikti, Universitas Islam Raden Rahmat, Malang, Indonesia

References


Text Mining to Analyse Publication Topics of COVID-19 using HDP and LDA Methods

Rakhmah Wahyu Mayasari¹, Kartika Fithriasari², Dedy Dwi Prastyo³
{rakhmah13@mhs.statistika.its.ac.id¹, kartika_f@statistika.its.ac.id², dedy-dp@statistika.its.ac.id³}

¹Department of Statistics, Faculty of Science and Data Analytics, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia

Abstract. COVID-19 is a disease caused by the novel coronavirus, which almost all countries are affected. This worldwide effect has led many researchers to conduct research related to COVID-19. It is wanted to know what topics have been carried out from all the studies published by researchers in various countries. This research analyzes the data crawled from full abstracts of publications related to COVID-19 start January 2020 to August 2020. The abstract's text was crawled and then preprocessed by eliminating punctuation, lowering text, lemmatizer, and stopword. Furthermore, the clean data is ready for analysis using the text mining method to allocate topics and use as future research information. The methods used are the Hierarchical Dirichlet Process (HDP) and Latent Dirichlet Allocation (LDA) approaches. It also found that the LDA method has a coherence score of 42% higher than the HDP method, which means LDA is more appropriate in this case.

Keywords: COVID-19, Hierarchical Dirichlet Process, Latent Dirichlet Allocation, Text Mining

1 Introduction

At the end of 2019, a type of virus emerged by the novel coronavirus, namely Coronavirus Disease 2019 (COVID-19). COVID-19 is a new type of disease that has never been previously identified in humans, where the virus that causes COVID-19 is called Sars-CoV-2. On December 31, 2019, the WHO China Country Office reported pneumonia of unknown etiology in Wuhan, Hubei, China. Until one month later, on January 30, 2020, the WHO has announced that this disease is a Public Health Emergency of International Concern (PHEIC). The transmission of COVID-19 is fast and has spread to other countries. As of March 25, 2020, cases were reported in 192 countries exposed to COVID-19. Scientists in almost all countries have researched COVID-19. Many studies have been published so that the public can obtain information from the results of these studies. Most of the research results are stored in the Science Direct database.

Science Direct is a database that contains a collection of quality full-text documents checked by Elsevier reviewers. More than 1.2 million articles have been collected, accessed freely through the Science Direct database. The Science Direct database also contains thousands of research related to COVID-19. From these thousands of studies, an idea emerged to find out
what topics are about. The appropriate analysis to use is text mining analysis, which is part of
data mining analysis.

Text mining is an analysis where the data uses text data. This analysis is a branch of data
mining science conducted to obtain quality information from a series of texts in a document [1-
3]. In-text mining, the topic modeling technique is very appropriate to do in this analysis. The
topic modeling technique is used to get topics that match a set of documents. The methods in
topic modeling techniques that are still being developed to date include Latent Semantic
Indexing (LSI), probabilistic Latent Semantic Indexing (pLSI), Latent Dirichlet Allocation
(LDA), and Hierarchical Dirichlet Process (HDP). Research has been conducted by [4], which
concluded that the Hierarchical Dirichlet Process (HDP) has better sensitivity and accuracy than
the C-word and Cocitation methods. Another study concludes that LDA is a popular text mining
analysis method in research from 2000 to 2017 [5]. Research on topic modeling was also carried
out by [6] to determine the research subject for each document (publication) and see research
trends regarding libraries, archives, and museums. In this study, the topic modeling technique
will carry out on the data publication topics of COVID-19 by employing the HDP and LDA
methods. The best approach is selected based on the coherence score.

1.1 Text Mining

Text mining is an analysis where the data uses text data. This analysis is a branch of data
mining science conducted to obtain quality information from a series of texts in a document [1-
3]. Text mining's primary focus is on how many documents can be divided into several groups
based on the document type. These extensive documents must be prepared with data to be
processed before grouping analysis. So before analyzing or grouping the data, it is necessary to
prepare data, commonly called preprocessing data. Data preprocessing is done to prepare the
text data ready for text mining analysis [7].

1.2 Pre-processing Data

Preprocessing text is the text data preparation stage that needs to be done before proceeding
to the analysis. This step needs to be done first because the raw text data obtained is
unstructured, and the text mining process cannot be carried out. The stages of data preprocessing
are as follows.
1) Case Folding. This stage is used to change all text characters to lowercase letters (not
capital letters) and eliminate numbers and punctuation marks. The procedure in the case
folding step is processing the letters of the alphabet “a” to “z” so that non-alphabet
characters be removed as well as punctuation and numbers [8].
2) Tokenizing. It is the stage of deciding word for word in a sentence. This stage aims to
break the sentence into word pieces to break the strings’ sequence into pieces of their
constituent words [9].
3) Lemmatizer. It is the stage for obtaining essential words. The procedure of this lemmatizer
stage is to remove affixes in words. For example, the term "drugged," "drugs," "drugging"
has the same root word, namely "drug," so that at this steaming stage, the word is replaced
with the word "drug" [10].
4) Stopword. It is the stage of removing vocabulary that is not a unique word or does not
convey any message significantly to the text. The vocabulary referred to is such as
conjunctions and adverbs such as "and," "our," "from," and so on [11].
5) Topic Modeling. Topic modeling is a technique in machine learning that is classified as an
unsupervised method. This technique is used to get topics from a set of documents, where
this document contains text [12]. From this set of documents, statistical modeling will be
carried out to obtain the topic by first obtaining the document patterns [13]. There are several methods of topic modeling. Starting from the Latent Semantic Indexing (LSI) method in 1990, then developed into a probabilistic Latent Semantic Indexing (pLSI) in 1999. Then it was developed again until 2003 introduced Bayesian from pLSI, namely Latent Dirichlet Allocation (LDA). In contrast with the LDA, there is a method of topic modeling that also adheres to the principle of Bayesian Hierarchical Dirichlet Process (HDP) in 2005.

1.3 Hierarchical Dirichlet Process (HDP)

Hierarchical Dirichlet Process (HDP) is a method of topic modeling that uses a mixture model in its component division. In this HDP method, it is assumed that a group \( j \) will be formed, where the number of components in each group is \( n_j \). It is also assumed that each group's data points are easy to exchange, and from that data, the point will be set up with a mixture model. Each model that is formed will have a particular proportion forming a different group. This step is needed because each group has different characteristics resulting in a different combination of proportions.

\[
G_{0j} | \gamma, H \sim DP(\gamma, H) \\
G_j | \delta, G_0 \sim DP(\delta, G_0) \\
\varphi_{i|j} | G_j \sim \pi \\
x_{ij} | \varphi_{ij} \sim F(\varphi_{ij}) .
\]  

Where \( G_0 \) is the overall probability measure, and \( G_k \) is the probability size in each group \( k \). \( G_0 \) contains the \( DP(\gamma, H) \) distribution where \( H \) is the baseline measure and \( \gamma \) is the concentration parameter. Whereas each group \( G_k \) is conditionally independent, containing the \( DP(\delta, G_0) \) distribution. Also known, each \( x_{ij} \) has a factor \( \varphi_{ij} \) with \( F(\varphi_{ij}) \) the distribution. An illustration of the distribution \( G_0 \) as in Figure 1 below [14].

![Fig. 1. HDP model illustration with three topic output](image)

Figure 1 shows the distribution content at each point, and also illustrates the position and parameters used. It is also illustrated that the output (topic) formed is 3.

1.4 Latent Dirichlet Allocation (LDA)
Latent Dirichlet Allocation (LDA) is a development method of pLSI developed by Blei et al. in 2003. This method is one of the models that has been proven effective in making models on the topics that are formed, and this method is the most frequently used method in text mining related analysis in 2000–2017 [5]. The LDA method is very representative in making topics in every document, where the topic contains a multinomial distribution of a set of words in each document. If illustrated in a diagram, it will be as in Figure 2 below

![Fig. 2. Illustration of the LDA Method](image)

Based on Figure 2, the equation for the LDA method can be written as follows.

\[
p(w, z, \theta, \alpha, \beta) = p(\theta | \alpha) p(z | \theta) p(\phi | \beta) p(w | \theta, \phi)
\]

\[
= \left( \prod_{d=1}^{D} \frac{\Gamma(\alpha_d)}{\prod_{k=1}^{K} \Gamma(\alpha_k)} \prod_{i=1}^{V} \theta_{d,k}^{\alpha_i-1} \right) \left( \prod_{k=1}^{K} \frac{\Gamma(\beta_k)}{\prod_{v=1}^{V} \Gamma(\beta_v)} \prod_{n=1}^{N} \phi_{k,v}^{\beta_v-1} \right)
\]

(2)

In the LDA method, it is assumed that the characteristics of a topic are determined by the distribution of the words in it. Where a collection of words referred to a document, and a set of documents called the corpus. While a collection of terms/words in the corpus, is called vocabulary. In the LDA method, the concept of the process starts from determining the number of topics, then initializing the topics randomly to the words in it. This applies to every document in the corpus. Furthermore, the calculation of the probability value of the topic in the document, as well as the probability of words on the topic. This aims to see the accuracy of the topic in the document and the probability of words on the topic.

1.5 Score Coherence

The grouping results need to be evaluated to know the consistency of the model in a grouping. The topic evaluation used is the calculated coherence score, where coherence is suitable for assessments related to the topic's quality [15]. There are two methods of calculating the coherence value, namely measurement using UCI and UMass. UCI measurement is done by calculating Pointwise Mutual Information (PMI) between two words. Equation 3 describes the calculation of the score for the UCI measurement as follows.

\[
score(v_i, v_j, \epsilon) = \log \frac{p(v_i | v_j) + \epsilon}{p(v_i) p(v_j)}
\]

(3)
Meanwhile, the UMass measurement is done based on the appearance of words in the document being modeled. The score calculation for UMass measurement is as in Equation (4) below.

$$\text{score}(v_i, v_j, \varepsilon) = \log \frac{D(v_i, v_j) + \varepsilon}{D(v_j)}$$, \hspace{1cm} (4)

Where $v_i$ is the word $(i)$ and $v_j$ is the word $(j)$, $I \neq j$. $p(v_i)$ is the probability of the word, which is obtained from the frequency of occurrence of the word $(i)$ in the full document. $p(v_j)$ is the probability obtained from the frequency of occurrence of the word $(j)$ in the full document [16]. Meanwhile, for the UMass measurement, it is known that $D(v_j)$ is the number of documents that contain at least one word $(i)$ and $D(v_i, v_j)$ is the number of documents containing at least one word $(i)$ and one word $(j)$ [17]. $\varepsilon$ is a smoothing factor that aims to form a real number. Some sources use one as a substitute $\varepsilon$. The calculation of the coherence value is explained as in Equation 5 below.

$$\text{coherence}(V) = \sum_{\{v_i, v_j\} \in \Gamma} \text{score}(v_i, v_j, \varepsilon)$$ \hspace{1cm} (5)

Equation (5) states that the coherence score is the sum of the scores on each formed topic.

2 Method

The data used in this study is a set of abstracts obtained from research journals that have been published in the Science Direct database. Data collection in the Science Direct database was carried out in journals published between January 2020 and August 2020. Data was collected by scraping it on the official Science Direct website. Not all publishers were included in this analysis, but only 35 publishers because only specific articles contain abstracts that can be used as data in this study. Apart from the type of article, the site score is also a consideration. Only publishers with a cite score of at least one are selected. The keywords used in the determination of the journal are "COVID-19", "2019-nCoV", "SARS-CoV-2", or "SARS-COV-2". From the journals that have been obtained, the abstract collection is done by scraping each publication from the selected publisher. The abstract scraping results are then carried out with preprocessing in several stages, i.e., case folding, tokenizing, lemmatizer, and stopword. After obtaining the appropriate data, topic modeling analysis was carried out using the HDP and LDA methods. An investigation is carried out until it is found that the optimal coherence score between the two methods and the optimal number of topics.

3 Result and Discussion

The data used is data from scraping on publications related to COVID-19. The scraping results found that several published journals do not contain abstracts such that they were excluded from the analysis. There are 4451 publications obtained from scraping, but only 2264 journal publications contain abstracts. These 2264 documents will be analyzed further.
The document containing abstracts were preprocessed with the case folding, tokenizing, lemmatizer, and stopword stages. This preprocessing stage is carried out by changing all letters to non-capital letters, then removing punctuation marks. Furthermore, the sentence breakdown is carried out into words to form word fragments in each sentence. Next, transform the words into essential words. Having obtained the essential words, then remove some terms such as "and," "our," "from," etc. Any other words that are not needed are omitted, i.e., 'covid-19', '2019-novel', 'sars-ncov-2', etc. were also removed from the data.

The data has been through preprocessed cleansing so that the data is in the appropriate state. The data is ready to be analyzed to perform topics modeling using the HDP method, resulting in a coherence score as the graph in Figure 2.

Figure 4 shows the coherence score for each number of topics from 2 groups up to 20 groups. From all the groups tested, it can be seen that the peak in the number of groups is 8. Using the HDP method, the best number of groups is eight groups, indicated by the highest coherence score. Furthermore, LDA method, coherence score results are known as in Figure 3.
Figure 5 shows that using the LDA method can determine the best number of topics in nine topic groups, where the coherence score is 0.56. From the HDL and LDA methods that have been done, the two approaches can be compared to determine which method gives optimal results.

![Figure 5](image.png)

**Fig. 5. Comparison Topic Modeling Method**

Figure 6 shows the comparison of the score coherence between the HDP and LDA methods. From Figure 4, it can be seen that the average coherence score of the LDA method is higher than HDP. It can be seen that the average coherence score of the LDA method is 0.51, while the HDP score is 0.38. So that from the coherence score, it can be determined that the LDA method is more appropriate to use in the abstracts of journal publications related to COVID-19. The optimal number of topics is nine, where the coherence score on the number of nine topics with the HDP method is 0.39, while the LDA method is 0.56. So it can be seen that in the number of topics 9, the LDA method is 42% higher than the HDP method. Using the LDA method, we can find out the ten words most often appear in the document for each topic, which can be written in Table 1 below.

**Figure 6. Comparison Topic Modeling Method**

**Table 1. Allocation Topic by LDA Method**

<table>
<thead>
<tr>
<th>Topic 1</th>
<th>Topic 2</th>
<th>Topic 3</th>
<th>Topic 4</th>
<th>Topic 5</th>
<th>Topic 6</th>
<th>Topic 7</th>
<th>Topic 8</th>
<th>Topic 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>el</td>
<td>data</td>
<td>case</td>
<td>data</td>
<td>material</td>
<td>death</td>
<td>infection</td>
<td>positive</td>
<td>immune</td>
</tr>
<tr>
<td>Los</td>
<td>disease</td>
<td>clinical</td>
<td>propose</td>
<td>surface</td>
<td>study</td>
<td>respiratory</td>
<td>result</td>
<td>ace2</td>
</tr>
<tr>
<td>SMD</td>
<td>care</td>
<td>severe</td>
<td>dataset</td>
<td>manufacturing</td>
<td>rate</td>
<td>drug</td>
<td>negative</td>
<td>receptor</td>
</tr>
<tr>
<td>pacientes</td>
<td>measure</td>
<td>respiratory</td>
<td>predict</td>
<td>force</td>
<td>number</td>
<td>disease</td>
<td>case</td>
<td>cytokine</td>
</tr>
<tr>
<td>growth</td>
<td>country</td>
<td>symptom</td>
<td>method</td>
<td>part</td>
<td>lockdown</td>
<td>may</td>
<td>detection</td>
<td>lung</td>
</tr>
<tr>
<td>GC</td>
<td>case</td>
<td>report</td>
<td>result</td>
<td>energy</td>
<td>country</td>
<td>potential</td>
<td>RT-PCR</td>
<td>response</td>
</tr>
<tr>
<td>se</td>
<td>impact</td>
<td>infection</td>
<td>process</td>
<td>manufacture</td>
<td>confirm</td>
<td>cause</td>
<td>antibody</td>
<td>increase</td>
</tr>
<tr>
<td>p</td>
<td>system</td>
<td>associate</td>
<td>analysis</td>
<td>tool</td>
<td>increase</td>
<td>human</td>
<td>assay</td>
<td>storm</td>
</tr>
</tbody>
</table>
Based on table 1, it can be seen that each topic has its characteristics. Ten words that often appear on each topic can be used as material to determine the topic's theme. As the first topic can be summarized as "growth," the second topic is "impact," and the following topics are "symptoms," "methods and analysis," "manufacturing tools," "the increasing number of confirmed deaths," "virus detection," and "body resistance." In contrast to the LDA method, the HDP method is quite challenging to determine the theme of each topic. This result happened because the ten most frequently occurring words from the HDP method do not have their respective characteristics, so they are almost the same in each topic. This is a drawback of the HDP method, in addition to the relatively small coherence score. So that, indirectly, it can be seen that the advantages of the LDA method are the relatively high coherence score and the ease of knowing the characteristics of each topic that is formed.

4 Conclusion

Based on the empirical results, this research concludes that in this case, the LDA method has a coherence score that is 42% higher than the HDP method. Besides, the LDA results are more comfortable determining the theme of each topic than the results from the HDP method. Also note that the best number of topics is nine topics, i.e., "growth," "impact," "symptoms," "methods and analysis," "manufacturing tools," "increase in confirmed death count," "virus detection," and "immune system." The theme of these topics can be used as input for researchers to focus on the further development of research related to COVID-19.

References


Synthesis and Characterization of Samarium or Lanthanum-Based Metal-Organic Frameworks with Crysophenine Ligand

Riska Yulianiza¹, Agustino Zulys², Jarnuzi Gunlazuardi³
{riska.yulianiza71@ui.ac.id¹, zulys@sci.ui.ac.id², jarnuzi@ui.ac.id³}

Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Indonesia, Depok, West Jawa, Indonesia 16424¹,²,³

Abstract. Lanthanide (Ln) Metal Organic Frameworks (Ln: Sm or La-MOF) have been synthesized with chrysophenine ligand (CH) by solvothermal method. Furthermore, vibration spectroscopy, crystallography, morphology, and bandgap value of MOFs have also been studied. The FTIR result for Sm-MOF showed absorption peak shift of C=O stretching mode in DMF to the lower wavenumber means Sm-MOF were successfully formed and the FTIR result of La-MOF showed a sharp peak at 1571.27 cm⁻¹ which confirmed the success in formation of La-MOF. XRD results for both of the MOF showed crystalline characteristic. Still, for La-MOF indicated higher crystallinity, it revealed from SEM/EDS result which showed uniform arrangement between La and chrysophenine. EDS data proved the composition of La, O, C, and S from chrysophenine in La-MOF. UV-DRS data showed the bandgap for Sm-MOF was 2.09 eV at 590 nm and La-MOF was 1.98 eV at 623 nm which means Ln-MOFs can be used as photocatalyst material under visible region.

Keywords: MOFs, Chrysophenine, Photocatalyst

1 Introduction

The increment of the human population on earth will cause much energy to help their activities like fossil fuel for transportation. However, this kind of fuel has been predicted will be used only until 2050 [1]. Therefore, scientists already start to find alternative energy. One of the efforts is utilizing sunlight as an energy source, which can change water into hydrogen and oxygen gas (water splitting). Hydrogen gas can be alternative energy because it’s environmentally friendly and renewable [2]. Photocatalysis is one of the approaches to doing that process and utilizing sunlight as the source of energy [3].

Photocatalysis was first introduced by Fujishima and Honda in 1972 using TiO₂ as the electrode under UV light [4]. However, bandgap of TiO₂ is high for this process (3.2 eV for anatase phase and 3.0 eV for rutile phase) and because of that only UV light can be absorbed (the percentage of it less than 5 % in sunlight). Simultaneously, photocatalysis in water splitting is expected to work under visible light because the percentage of it is 40 % in sunlight. Moreover, Fe₂O₃ and BiVO₄ can be used as the electrode for the photocatalysis process. Fe₂O₃ is an earth-abundant, stable, and non-toxic material with an ideal bandgap (1.9-2.2 eV), but it has low mobility characteristics and slows at oxidation because of high surface area. Meanwhile,
BiVO$_4$ as photocatalyst material with bandgap 2.4 eV and conduction band near 0 V$_{RHE}$ looked promising but need external bias for reduction and oxidation [5]. Therefore, research by scientists to find suitable photocatalyst material for water splitting in the visible region should be done to get alternative energy for our earth.

Scientists start to find suitable photocatalyst material by using Metal-Organic Frameworks (MOF). MOFs are a type of micropore crystalline material consisting of metal ions (or cluster) coordinated with organic molecule multidentate. MOFs have two essential parts, they are metal cation/cluster (it could be transition metals, 3p metals, or lanthanides) and organic linker (two carboxylates or more-, pyridyl-, or isolate functional group as cluster linker) [6]. MOFs have some advantages like a high volume ratio to the surface area, flexible design. They can also be used in visible regions and tunable porosity for hydrogen gas production in the water splitting process [4].

Water splitting will occur when the applied potential is 1.23 V at pH = 0 per 1 electron. Therefore, suitable photocatalyst material for this process should have a bandgap of more than 1.23 V or around 2.0 V, which can work under the visible region ($\lambda = 400$-$780$ nm). To achieve this goal, scientists have to consider metal (active site) in MOFS for water splitting. Metals from lanthanide like Samarium (Sm) and Lanthanum (La) can be considered for MOFs because lanthanide ions exhibited high amount of coordination number and diverse networking, which could create various and unpredicted structures of MOFs. Beside that, lanthanide ion as central ion in MOFs are widely adopted for tuning light absorption to ensure an efficient utilization of solar energy [7] MOFs based on lanthanide are very promising since organic linkers could act as an antenna that produces succesful photosensitization [8]. A photosensitizer like chrysophenine is an organic substance and organometal which can absorb and transfer visible light to the active site (metal) to become electron and make water reduction.

In this research, MOFs were made from samarium or lanthanum metal as the active site with chrysophenine as organic linker by solvothermal method at 170°C for 72 h with the usage of solvents like dimethylformamide (DMF) and water. Furthermore, the characterization of MOFs was done by FTIR, XRD, SEM-EDS and UV-Vis DRS.

## 2 Materials and Methods

All the chemicals used in this research were purchased from commercial sources and used without further purification. Multiple instruments such as Fourier Transform Infra-Red (FTIR) Prestige 21 Shimadzu, X-Ray Powder Diffration (XRD), Shimadzu 6000, Scanning Electron Microscopy (SEM), and Diffuse Reflectance UV-Vis Shimadzu spectrophotometer 2200A were used for characterization of Ln-MOFs-CH.

### 2.1 Synthesis of Lanthanide-MOFs (Sm-MOF and La-MOF)

Ln-MOFs were synthesized by the solvothermal method by pouring each one mmol of Sm(NO$_3$)$_3$.6H$_2$O and La(NO$_3$)$_3$.6H$_2$O with one mmol chrysophenine in 4 mL dimethylformamide (DMF) and 11mL H$_2$O. Each system was stirred for 45 minutes and then moved to Teflon autoclave and heated for 72 hours at 170°C. Furthermore, the crystals were washed using equates and DMF, then dried in the oven at 60-80°C for 24 hours.
2.1 Characterization of Lanthanide-MOFs (Sm-MOF and La-MOF)

Several instruments characterized the synthesized Ln-MOFs. FTIR was used to identify functional group and shift of absorption peak in MOFs with KBr as the pellet. XRD was used to check the crystallinity of MOFs. SEM was used to look at the morphology of MOFs and EDS to confirm the composition in MOFs. Furthermore, UV-Vis DRS was used to find the bandgap of MOFs formed.

3 Results and Discussion

Sm-MOF and La-MOF were synthesized by reacting each precursor Sm(NO$_3$)$_3$.6H$_2$O and La(NO$_3$)$_3$.6H$_2$O with chrysophenine ligand in DMF and water solvent. The polarity of the solvent used will control crystal growth [9]. DMF was used as the solvent because it has high polarity, good synthetic value until high-temperature, good thermal stability (even at the boiling point, 153°C) and a wide range of solubility in the organic or inorganic compound [10]. The method used in this research was a solvothermal method, which is single crystal synthesis and other compounds that depend on mineral solubility in the solvent at a temperature higher than 100°C, and it can form good quality MOF crystal for the structural characterization [9]. Characterization of synthesized MOFs were done by FTIR, XRD, SEM-EDS, and UV-DRS.

FTIR was used to identify the functional group in Sm-MOF and La-MOF at the range of wavenumber from 500 until 4000 cm$^{-1}$. Fig. 1 (a) showed sharp peaks were confirmed the absorption peak shift from vibration C=O stretching mode of DMF shifted to the lower wavenumber from 1671 to 1650.89 cm$^{-1}$ shows the complex interaction between DMF and Sm-MOF were successfully formed. The other is at 1601.12 cm$^{-1}$ indicated that C=C from chrysophenine ligand shifted to the higher wavenumber from 1597.81 to 1601.12 cm$^{-1}$, also showing the interaction of C=O with Sm$^{3+}$ occur. Furthermore, peaks at 2981.15 cm$^{-1}$ (sharp peak) and 3352.69 cm$^{-1}$ (broad peak) showed the O-H stretching mode from water molecules in Sm-MOF [8]. Fig. 1 (b) showed two sharp peaks at 1352.32, and 1402.08 cm$^{-1}$ indicated both symmetry and asymmetric vibrations of C=O, respectively. Furthermore, a sharp peak at 1571.27 cm$^{-1}$ was observed. It indicated the success of the complex interaction between C=O from DMF with La$^{3+}$ and absorption peak at 3455.53 cm$^{-1}$ revealed O-H functional group from water [8].

![Fig. 1. FTIR spectra result of (a) Sm-MOF and (b) La-MOF](image-url)
The crystallinity of synthesized MOFs was then observed by using XRD. The result is Sm-MOF and La-MOF have crystallinity characteristics, but La-MOF showed higher crystallinity than Sm-MOF, as shown in Fig. 2. La-MOF has characteristic peaks at 16.5 and 33.38 while Sm-MOF at 4.16 and 8.32. Moreover, SEM-EDS is used to look at the morphology, and EDS identifies the MOF’s composition. From SEM result showed that La-MOF has a uniform arrangement of the active site (La$^{3+}$). The EDS revealed La, O, C, and S from the chrysophenine ligand as shown in Fig. 3 and 4.

![Fig. 2. XRD Pattern for (a) Sm-MOF and (b) La-MOF](image)

![Fig. 3. SEM image of La-MOF with scale bar 200 µm](image)

![Fig. 4. EDS spectra of La-MOF](image)
Table 1. Composition in La-MOF

<table>
<thead>
<tr>
<th>Element</th>
<th>Weight (%)</th>
<th>Atoms (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>10.98</td>
<td>31.36</td>
</tr>
<tr>
<td>N</td>
<td>01.22</td>
<td>02.99</td>
</tr>
<tr>
<td>O</td>
<td>21.62</td>
<td>46.36</td>
</tr>
<tr>
<td>Ni</td>
<td>07.16</td>
<td>04.19</td>
</tr>
<tr>
<td>S</td>
<td>00.64</td>
<td>00.69</td>
</tr>
<tr>
<td>La</td>
<td>58.38</td>
<td>14.42</td>
</tr>
<tr>
<td>C</td>
<td>10.98</td>
<td>31.36</td>
</tr>
</tbody>
</table>

Measurement of bandgap value is one of the requirements to check whether the material can be utilized as a photocatalyst or not. Bandgap value means how much energy is required by photocatalyst for photocatalysis process and determines wavelength from the light source, whether in UV or visible light range. Characteristic of photocatalyst which can be used under visible light (400-700 nm) is having bandgap range around 1.9-2.2 eV.

![Fig. 3. Bandgap measurement of (a) Sm-MOF and (b) La-MOF](image)

Measurement of the bandgap for both Sm-MOF and La-MOF are showed in Fig. 5 by using the Tauc plot, and the results of reflectance were converted to Kubelka-Munk function with curve F(R) as the result. UV-DRS data showed that the Sm-MOF bandgap was 2.09 eV at 590 nm and La-MOF was 1.98 eV at 623 nm which confirmed that Sm-MOF and La-MOF can be used as photocatalyst material under visible region.

4 Conclusion

In this research, Sm-MOF and La-MOF were successfully synthesized by using the solvothermal method. From FTIR result, there was absorption peak shift of DMF to the lower wavenumber from 1671 to 1650.89 in Sm-MOF indicated the ligation between DMF and Sm-MOF formed, and there was sharp peak observed at 1571.27 cm\(^{-1}\) in La-MOF indicated complex interaction between La\(^{3+}\) ions and C=O formed. XRD result showed that La-MOF has higher crystallinity than Sm-MOF, it revealed from SEM-EDS result, which showed uniformly
arrangement of La and chrysophenine as the ligand. Bandgap value of Sm-MOF and La-MOF were obtained from UV-DRS. Sm-MOF’s bandgap value was 2.12 eV at 585 nm, and La-MOF was 2.07 eV at 599 nm. These data showed that Sm-MOF and La-MOF suitable as photocatalyst material under visible light (ideal bandgap 1.9–2.2 eV) for further application in the water-splitting process.

Acknowledgments. The authors would like to acknowledge the Directorate of Research and Community Engagements, Universitas Indonesia, to support this research through Hibah PUTI UI 2020. The authors also state that no conflict of interest in this research.

References

The Development of Android Educational Game “MENALAR” for Ten Grade High School Students

Ryan Angga Pratama1, Rahayu Sri Waskitoningtyas2
{ryan.angga@uniba-bpn.ac.id, rahayu.sri@uniba-bpn.ac.id}

Universitas Balikpapan, Jl. Pupuk Raya Kelurahan Gunung Bahagia, Balikpapan, Indonesia1,2

Abstract. This study aims to produce distance learning media using Adobe Animation CC, namely educational game “MENALAR” which can be played on a smartphone. The product is developed by paying attention to the aspects of validity, practicality, and effectiveness in learning mathematics in X Grade of SMA Negeri 5 Balikpapan and SMA Negeri 6 Balikpapan. The implementation uses the Multimedia Development Life Cycle (MDLC) development design which consists of: concept, design, obtaining content material, assembly, testing, and distribution. These results were obtained from media testing consisting of Alpha and Beta test. The results of the study concluded that the “MENALAR” educational game was included in the very valid category with a percentage of 87.6%, very practical with an average percentage of 83.6%; and effective with a percentage of completeness reaching 61.8%. So that overall the developed learning media can be an alternative in learning activities, especially regarding mathematical reasoning problems.

Keywords: Android, Adobe Animation CC, MENALAR.

1 Introduction

NCTM [1] argues that in learning mathematics students are required to have mathematical communication skills, mathematical reasoning, mathematical problem solving, mathematical connections, and mathematical representations. Thus, reasoning is one aspect of high-order mathematical thinking skills that students must have [2, 3]. In addition, the learning process in the 2013 Curriculum for the primary and secondary levels is carried out using a scientific approach which includes observation, asking, experimenting, processing information, presenting data, analyzing, reasoning, concluding and creating, and communicating [4]. Based on this, it is clear that mathematical reasoning ability is also a very important and essential aspect. Realizing the importance of mathematical reasoning in learning structures in the current curriculum, learning is needed that can improve students' mathematical reasoning. One way that can be used to improve students' mathematical reasoning and communication skills is to use learning media effectively and efficiently.

Based on the results of interviews with mathematics teachers at SMA Negeri 5 Balikpapan, teachers have used learning media such as Microsoft PowerPoint. However, the teacher did not invite students to think critically. This can be seen from examples of reasoning questions in textbooks that are rarely discussed so that students are not accustomed to being critical and constructing their own knowledge. Furthermore, with regard to the use of information and communication technology in the mathematics learning process, teachers more often ask...
students to learn by using Google Classroom, searching on Google, and watching YouTube. This really supports students to learn independently and construct their own knowledge, but also has the potential to be misused by students for just playing. For example, students tend to be engrossed in the learning process alone or play with their smartphones when the teacher is explaining.

As we known, the rapid technological advances have led to information technology-based learning processes using computers [5], or other devices such as smartphones. Today's cell phones are known as smartphones, enabling a variety of features, including multimedia. This feature has the potential to be used for educational purposes [6]. According to Pratama et al [7] and Bahauddin & Setyaningrum [8], the use of android smartphones is currently more widely used as a means of entertainment than education. On the other hand, so many users of the Android in Indonesia [9], especially teenage or high school students, make it an opportunity for teachers to develop various learning media in digital era. So that, the development of smartphones is not only limited to communication tools, but nowadays it has been widely used as a learning media [10].

Learning on Android smartphone is one of the alternatives in learning that are fun and interesting [10]. One of the Android based learning media that is often used is games (in this research: math games). Educational games are fun games or activities that contain educational content [11, 12]. Another definition, educational games are a combination of education and entertainment designed to stimulate student thinking [8, 12, 13]. Research studies related to educational games also show positive results. It is known that educational games have a motivational effect in the classroom, and students get more learning opportunities than conventional learning [9]. In addition, educational games also have an effect on improving the academic performance of high school students and are effective on student learning outcomes [14, 15]. Thus, it is clear that the use of games in the world of education is a form of renewal, which will provide various positive impacts in the learning process.

Based on the problems that have been described, also seeing the potential use of information and communication technology in learning in today's digital era and the importance of students' reasoning abilities, it is necessary to develop learning media products that can be used to support student learning and reasoning activities. The product is an educational game based on Adobe Animation CC which is named “MENALAR”. According to Wibawanto [16], Adobe Animation CC is computer software designed by the Adobe System that can be used to create various types of projects including animation, interactive media, games, smartphone applications, and so on. The development of this learning media is very important; especially applying it in learning in the current conditions of the Covid-19 pandemic. By using educational games, students will be able to learn independently, be responsible, and are expected to improve their outcomes or mathematical reasoning.

2 Method

2.1 Research Design

This research is a research and development that is used to produce products and test the effectiveness of these products [17]. The development model uses Luther's design, namely Multimedia Development Life Cycle (MDLC) developed by Sutopo [18].
2.2 Data Collection Techniques
Data collection was carried out by means of documentation, tests, and questionnaires. The data collection instruments are as follows:
1. Documentation; Documentation in the form of photos or screenshots during the research.
2. Test; The test is in the form of 15 reasoning questions in X Grade material, namely: one-variable linear equations and inequalities, a three-variable system of linear equations, a two-variable linear inequality system, functions, and trigonometry.
3. Questionnaire; (a) Questionnaire for media experts; contains an assessment based on aspects of audio, software engineering, and visual appearance. (b) Questionnaire for material experts; contains an assessment based on the quality aspects of reasoning practice questions, and the effect on learning strategies. (c) Questionnaires for practitioners/teachers and students; contains assessments based on aspects of the quality of the content of reasoning questions, effects on learning strategies, and aspects of software engineering.

Furthermore, the Likert scale was used as a reference in preparing the questionnaire. The Likert scale provides five answer options with the following format: Strongly Disagree = 1; Disagree = 2; Doubt = 3; Agree = 4; and Strongly Agree = 5 [17]. And then, the data analysis carried out was to analyze the validity, practicality, and effectiveness of the developed learning media.

2.3 Analysis of Validity and Practicality
The formula used is as follows [19]

\[ P = \frac{TSh}{TSe} \times 100\% \] (1)

Note:
\( P \) : Validity or practicality’s percentage
\( TSh \): Expected score
\( TSe \): Empirical score

The results of the analysis were then adjusted according to the interpretation of the scores as shown in the following table [20].

![Fig. 1. MDLC Development Cycle](image)
2.4 Effectiveness Analysis

Analysis of the effectiveness of the educational game “MENALAR” was carried out on the results of the reasoning tests obtained by students. The data were then analyzed by counting the number of students who were able to achieve the Minimum Completeness Criteria (KKM in Indonesia) that had been determined by the school, namely the value of 73. The data were interpreted into the effectiveness criteria with the following references [21].

<table>
<thead>
<tr>
<th>Percentage (%)</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p &gt; 80$</td>
<td>Very effective</td>
</tr>
<tr>
<td>$60 &lt; p \leq 80$</td>
<td>Effective</td>
</tr>
<tr>
<td>$40 &lt; p \leq 60$</td>
<td>Effective enough</td>
</tr>
<tr>
<td>$20 &lt; p \leq 40$</td>
<td>Less effective</td>
</tr>
<tr>
<td>$p \leq 20$</td>
<td>Very Less Effective</td>
</tr>
</tbody>
</table>

Note: $p$: The percentage of students who score above the KKM

Based on the table, the educational game “MENALAR” can be said to be effective if the percentage of the number of students who reach a score above or equal to the KKM, which is more than 60% of the total number of students who have played the game.

3 Results and Discussion

The research and development results obtained using the Multimedia Development Life Cycle (MDLC) development method are described as follows.

3.1 Concept

The concept and purpose of making the application are to help students in learning mathematics, especially regarding reasoning problems. The concept of offering an educational game is in the form of practicing reasoning questions as many as 15 items with a maximum time limit for each question is 5 minutes. At the end, a discussion of each question is also given.

3.2 Design

At this stage, the material construct and design of a storyboard to describe the stages of each scene.
3.3 Obtaining Content Material

Materials needed include: reasoning questions from several textbooks, pictures, animation, audio, and text. The equipment and equipment used are a laptop, USB flash disk, internet, and the Adobe Animation CC application.

3.4 Assembly

Following are some of the final displays of the "REALIZING" educational game products developed.

- Title Page and Display of Developer

![Fig. 2. Home Display](image1)

![Fig. 3. Display of Developer (Researcher) Profile](image2)

- Correct and Wrong Answer Pop Up Display

![Fig. 4. Correct Answer Pop Up](image3)

![Fig. 5. Wrong Answer Pop Up](image4)
3.5 Testing

There are two types of testing used, namely alpha and beta testing. The alpha test was conducted by two media experts, three material and learning evaluation experts, and three Mathematics learning practitioners. Meanwhile, the beta test is a test conducted by the user twice, namely small and large trials. For a small trial, the subjects were students of SMA Negeri 5 Balikpapan. While the large trial, the subjects are students of SMA Negeri 6 Balikpapan and students of SMA Negeri 5 Balikpapan.

The first process in testing is Alpha test. Alpha testing is carried out in one step to determine the feasibility of a learning media that is validated by 2 media experts, 3 material and learning evaluation experts, and also 3 learning practitioners. Due to the conditions of the Covid-19 Pandemic, all trials were carried out remotely.

**Alpha Test**


<table>
<thead>
<tr>
<th>Indicator</th>
<th>Alpha Score of Expert 1</th>
<th>Alpha Score of Expert 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound effects</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Backsound</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Color composition</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Font type</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Font size</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Text display</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Image / object placement</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Image proportions</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Display design</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Touch function</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Game flow</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Ease of operation</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>
In general, based on Alpha testing with Media Experts, the comments given are positive. The following are the results of the comments: “MENALAR” Games are very interesting and can help teachers in IT-based individual learning. In addition, the game is easy to operate because it comes with instructions for use. The lack of the educational game “MENALAR” includes aspects of completeness of the content and function of the buttons. The following are the results of the comments: the game should be equipped with discussion of answer keys, especially questions that were answered incorrectly by the user, and motivational sentences for the user can be added. Therefore, it needs to be revised before being tested on students.

In addition, the educational game “MENALAR” is also validated by material and learning evaluation experts. They filled out a questionnaire via the link: http://bit.ly/AngketAhliMateri.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Alpha</th>
<th>Score of Expert 1</th>
<th>Score of Expert 2</th>
<th>Score of Expert 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textbook compatibility</td>
<td></td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>KD conformity</td>
<td></td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Completeness of the questions</td>
<td></td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Systematically</td>
<td></td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>The clarity of the discussion material</td>
<td></td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>The clarity of the reasoning questions</td>
<td></td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Problem according to the text book</td>
<td></td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Display clarity</td>
<td></td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>The truth of the discussion about the matter</td>
<td></td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Difficulty level suitability</td>
<td></td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Usefulness in learning motivation</td>
<td></td>
<td>5</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Ease of independent study</td>
<td></td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Reasonable utility</td>
<td></td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>53</td>
<td>58</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td><strong>Percentage</strong></td>
<td>81,5%</td>
<td>89,2%</td>
<td>84,6%</td>
<td></td>
</tr>
<tr>
<td><strong>Criteria</strong></td>
<td>Very Valid</td>
<td>Very Valid</td>
<td>Very Valid</td>
<td></td>
</tr>
</tbody>
</table>

In general, based on the results of the questionnaire analysis from the three material experts on the Alpha test, comments were obtained: the game presented is quite interesting but needs to be added to the discussion. Thus, the “MENALAR” needs to be revised before being tested on students. Finally, the educational game “MENALAR” was also validated by three learning practitioners. They filled out a questionnaire via the link: http://bit.ly/AngketPraktisi. The following results were obtained:
<table>
<thead>
<tr>
<th>Indicator</th>
<th>Score of Expert 1</th>
<th>Score of Expert 2</th>
<th>Score of Expert 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textbook compatibility</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Compliance with KD</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Completeness of reasoning questions from the material</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Systematically</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>The clarity of the material</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>The clarity of the reasoning questions</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Problem according to the text book</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>The clarity of the question display</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>The truth of the discussion about the matter</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Difficulty level suitability</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Usefulness in learning motivation</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Ease of independent study</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Reasonable utility</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Learning media innovation</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Ease of operation</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Educational game flow</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Benefits in the world of education</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>68</strong></td>
<td><strong>80</strong></td>
<td><strong>74</strong></td>
</tr>
<tr>
<td><strong>Percentage</strong></td>
<td><strong>80%</strong></td>
<td><strong>94.1%</strong></td>
<td><strong>87%</strong></td>
</tr>
<tr>
<td><strong>Criteria</strong></td>
<td>Very Practical</td>
<td>Very Practical</td>
<td>Very Practical</td>
</tr>
</tbody>
</table>

Based on the table above, overall the educational game “MENALAR” received a positive response. Following are the results of the comments: the game is good and in the future it can be used for all types of smartphones (Android and Iphone), and the steps for discussing the questions are necessary.

Based on advice of the experts, the researcher then revised the educational game “MENALAR” by adding a discussion in the final scene. Here’s how it looks.
So that, Based on the Alpha Test analysis, it can be said that the assessment of the android educational game “MENALAR” by 8 experts was 87.6% (included in the Very Valid category to be tested). After being revised, then Beta testing was carried out to see the practicality of the educational game “MENALAR” being developed. Beta Test is carried out in two steps, namely the small group test and the large group test.

### Beta Test

The Small Group Test was held on April 30, 2020 on 15 subjects of class X-IPA-3 and 8 students of class X-IPA-4 of SMAN 5 Balikpapan. While the Large Group Beta Test was held on May 3, 2020 for 23 X-IPA-1 students, 13 X-IPA-2 students, 24 X-IPA-6 students, 14 X-IPS-1 students at SMAN 5 Balikpapan, and 15 students of X-IPA-4 SMA Negeri 6 Balikpapan. Following are the results of the questionnaire responses.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Small Score 23 students</th>
<th>Large Score 89 students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attractive appearance</td>
<td>89</td>
<td>354</td>
</tr>
<tr>
<td>Interesting sound effects</td>
<td>82</td>
<td>304</td>
</tr>
<tr>
<td>Easy touch function</td>
<td>101</td>
<td>379</td>
</tr>
<tr>
<td>Educational game flow</td>
<td>87</td>
<td>338</td>
</tr>
<tr>
<td>Ease of play</td>
<td>91</td>
<td>340</td>
</tr>
<tr>
<td>The clarity of the reasoning questions</td>
<td>93</td>
<td>353</td>
</tr>
<tr>
<td>Completeness of the reasoning questions</td>
<td>97</td>
<td>365</td>
</tr>
<tr>
<td>Completeness of the discussion questions</td>
<td>96</td>
<td>361</td>
</tr>
<tr>
<td>The suitability of the questions with the students' abilities</td>
<td>77</td>
<td>319</td>
</tr>
<tr>
<td>Variative and fun learning</td>
<td>95</td>
<td>344</td>
</tr>
<tr>
<td>Ease and motivation for independent learning</td>
<td>91</td>
<td>345</td>
</tr>
<tr>
<td>Usefulness of knowledge</td>
<td>91</td>
<td>352</td>
</tr>
<tr>
<td>The benefits of reasoning</td>
<td>94</td>
<td>356</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1184</strong></td>
<td><strong>4510</strong></td>
</tr>
<tr>
<td><strong>Percentage</strong></td>
<td><strong>79.1%</strong></td>
<td><strong>77.9%</strong></td>
</tr>
</tbody>
</table>

Based on the table above, it can be said that the android educational game “MENALAR” is included in the Practical category. Students also gave positive responses. The following include: (a) Interesting, fun and very helpful application, (b) Exercise is easy to understand, and (c) The application helps me to study independently. However, some of them provide comments or
suggestions: (a) Please extend the time, (b) Don't be too serious in the song or the backsound, and (c) We recommend that you give the "Pause" button.

Overall, based on the results that have been explained, it can be said that the android educational game "MENALAR" which was carried out by 3 practitioners and 112 students was 83.6% (Very Practical category).

3.6 Distribution
Applications are stored and distributed via smartphone devices as application package files (.apk). The distribution uses the following link: http://bit.ly/UnduhGameMENALAR. During the trial implementation, the mathematics teacher technically distributed the educational game "MENALAR" through the link provided by the researcher. The research implementation was also controlled remotely via the teacher's WhatsApp. Based on the teacher's report, it is known that their students are very enthusiastic about the games given. The teacher also asked students to collect the results of their calculations by being photographed. The following is a conversation between the researcher and the teacher and some of the calculation results of the students at SMAN 5 Balikpapan.

Fig. 9. Conversations between Researchers and Practitioners/Teachers
Fig. 10. Results of X-IPA-1 Student Work
IPA-4 Student Work

Fig. 11. Results of X-

Fig. 12. Results of X-IPA-6 Student Work
Overall, student learning outcomes in the Large Group Beta Test get good results, namely an average of 70.8 (included in the Effective category) or in other words 55 of 89 students (61.8%) exceed the KKM score of 73. Even though there was no direct observation due to the Covid-19 Pandemic conditions, students were still diligent in studying at home and solving the reasoning questions given in the educational game “MENALAR”. By playing the “MENALAR”, students are expected to be happy in learning or on the other word “learning while playing” using their smartphones. Then, they gave positive responses from an online questionnaire given via the link http://bit.ly/AnketSiswaMENALAR, and they were very interested too.

Here are some screenshots of student comments on Google Forms in their entirety.

![Fig. 13. Student comments on a Google Forms](image)

The use of android educational games can also generate interests and new desires, enhanced stimulation and motivation of learning activities [22], improve student learning outcomes [12], help improve cognitive understanding, as well as presenting material in an attractive and reliable manner [6]. Besides, the position of learning media with game is also a source of independent learning. An educational game not only be used as a learning aid, but can also be used by students with or without the teacher [11].

Several studies about educational games in learning also show the positive impact, especially in mathematics. With educational games developed, it is hoped that it can improve students' thinking skills, as in line with the research results of Aini, Ayu, & Siswati [5]. Android educational games can also improve students’ learning outcomes and affective [14] as well as metacognitive abilities and student learning independence [9]. In addition, one of the goals of developing the educational game “MENALAR” from researchers is to encourage students to actively participate in solving the problems given and think critically about the problems contained in the game. This is in line with the results of research by Rasyid, Gaffar, & Utari [23].

Overall, according to the validators, the educational game “MENALAR” that was developed had several advantages. The use of the “MENALAR” can be an alternative for distance learning.
independent learning, increasing student motivation to learn while playing, even though it turns out that the learning results obtained have not shown a score above 80. Furthermore, we know that the nature of the smartphone’s application that can be used anytime and anywhere [14], learning media like this can be played at any time so that the use of the media is said to be very practical. In addition, this media is also packaged clearly, the function of buttons is well, the coloring is attractive, and is accompanied by an encouraging background in order to build student motivation, so that students are interested in participating in mathematics learning, especially regarding reasoning problems. However, so far, the android educational game “MENALAR” also has limitations, including it cannot be played online, only 15 reasoning questions are given, can only be run on android smartphones, and it has not reached the distribution stage to the Google Play Store due to a longer review.

4 Conclusion

Based on the results of the research and development carried out, it can be concluded that the “MENALAR” Educational Game based on Adobe Animation CC which has been developed is in the very valid category with a percentage of 87.6%, very practical with a percentage of 83.6%, and effective with a percentage of 61.8%. Overall, the “MENALAR” are feasible and can be used as an alternative learning media in mathematics learning activities, regarding reasoning problems. The suggestions for the future are to develop similar educational games that are more interesting and their effectiveness can be measured using statistical t-test steps.

Acknowledgements. This research and development can be carried out well due to funding from the Directorate General of Research and Development (Ditjen Risbang) Dikti. Not to forget our gratitude to the Institute for Research and Community Service, University of Balikpapan.

References

Two-Dimensional Bayesian Information Criteria for Spatial Poisson Point Process (Case Study: Spatial Distribution Modeling of a Tree Species in Barro Colorado Island)

Sigit Dwi Prabowo¹, Achmad Choiruddin², Nur Iriawan³
{sigitprabowo@gmail.com¹, choiruddin@its.ac.id²*, nur_i@statistika.its.ac.id³}

Department of Statistics, Faculty of Science and Data Analytics, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia¹,²,³

Abstract. Species distribution modeling, where the distribution of specific species locations is connected to the environmental factors. Such data is called spatial point patterns, and the modeling is conducted based on the spatial point process. One central question is to select the best subset of such environmental factors that explain the best species distribution. Besides, the computational issue arises when numerous environmental factor is available. This paper focuses on developing a computational strategy to deal with variable selection through regularization methods for Poisson point process. In particular, two-dimensional Bayesian Information Criteria is proposed to select two types of tuning parameters. The first parameter plays the role of decreasing bias, and the second one improves the variances. Finally, the methodology is applied to tropical rain forest data in Barro Corrolado Island. The results show the adaptive elastic net regularization with the tuning parameters produces the best inhomogeneous poisson point process model.

Keywords: Two-Dimensional Bayesian Information Criteria, Regularization Methods, Species Distribution Modeling

1 Introduction

In ecology, one of the fundamental research areas is Species Distribution Modeling (SDM), where the aim is to explain the existence of a species associated with environmental factors [7]. Data on the existence of a species is included in the spatial point patterns data, and the modeling is conducted based on the spatial point process. The main focus in SDM is to choose the best covariate from the environmental factors that explain the distribution of the species.

In analyzing spatial point pattern data on SDM, the first step is determining the intensity value. Intensity act as a first-order characteristic of spatial point processes and has been a major focus in many studies, mostly when spatial covariates rely on the estimated strength. For example, a survey of spatial modeling of tree species distribution in forests related to environmental factors [8]. A Poisson point process is a common spatial point process because computational implementation is technically simple, and the poisson likelihood function can be systematically derived. In order to obtain parameter estimation results, the poisson likelihood function was developed to suit these models with the data [2].
The poisson likelihood function uses the regularization method to select the best covariate that describes the best model to determine the intensity value of the more optimal inhomogeneous Poisson point processes [3]. Many regularization methods have been studied previously, like ridge regression, LASSO, elastic net and other expansion, such as the regularization method that focuses on adaptive LASSO for the best model [8], then continued with research on the adaptive LASSO method that estimates value using cross-validation for optimal results [9]. Further investigation found that the adaptive Elastic-net regularization method with tuning parameter produces the best model compared to adaptive LASSO [3]. However, these studies only focus on estimating the first parameter, whereas, in the adaptive Elastic-Net regularization method, there is a second parameter that is not tuned so that the results of the estimation of the regularization method are not optimal by adjusting the parameters and where the first parameter plays a role in reducing bias and to increase the variance so that the best model is obtained. The criteria used to determine the optimal parameter tuning value are the two-dimensional Bayesian Information Criterion (BIC). BIC’s advantage as the criteria for selecting the best model is that it provides a penalty for adding parameters and is suitable for large data sizes.

This paper will focus on developing computational strategies to handle variable selection through regularization methods for spatial point processes. We will select the parameters simultaneously using the two-dimensional Bayesian Information Criteria (BIC). Finally, this methodology’s results were applied to the point data of the Beilschmiedia pendula Lauraceae tree species on the Barro Colorado Island.

2 Literature Review

2.1 Poisson Point Process

Let \( Y \) be a spatial point process on \( \mathbb{R}^d \). Let \( W \subset \mathbb{R}^d \) be a compact set of Lebesgue measure \(|W|\) which will play the role of the observation domain. A realization of \( Y \), \( m \) representing number of locations observed points in \( W \). Suppose \( Y \) has \( \lambda \) for intensity function and \( \lambda^{(2)} \) for second-order product density [3].

A point process \( Y \) is a Poisson point process on \( W \), if the following conditions are met:
1. if \( C_1, C_2, ..., \subset W \) are disjoint field, then \( N(C_1), N(C_2), ... \) are independent variable randoms
2. for any bounded \( C \subset W \), the number of point \( C \), \( N(C) \sim \text{Poisson} (\mu(C)) \)

Our research assumes that the function of intensity relies on a vector of parameters \( \beta \), i.e. \( \lambda(\beta) \), for the general spatial point processes model, as outlined in the introduction, maximum likelihood estimation is almost unfeasible. Instead of this approach, the Campbell formula offers an excellent tool to describe methods based on equations for estimating. In the form of spatial point processes, these approaches are now standard. The conventional parametric methods for evaluating \( \beta \) are obtained by maximizing the Poisson likelihood given respectively by:

\[
\ell(\beta) \approx \sum_{i=1}^M \left\{ y_i \log \lambda(u_i; \beta) - \lambda(u_i; \beta) \right\} \quad (1)
\]
where \( y_i = \frac{1}{v_i} \).

### 2.2 Regularized estimating equations

The Newton Raphson algorithm used to maximize the penalized log-likelihood function can be done using the iteratively reweighted least-squares (IRLS) method, as \( \ell(\beta) \) given by (1) is a concave function of the parameters. If the current estimate of the parameters is \( \hat{\beta} \), using Taylor’s expansion, we construct a quadratic approximation of the Poisson log-likelihood function [3]:

\[
\ell(\beta) = \ell(\hat{\beta}) + \frac{1}{2N} \sum_{i=1}^{N} v_i (\hat{y}_i - z_i^T \hat{\beta})^2 + C(\hat{\beta}).
\]

where \( C(\hat{\beta}) \) is a constant, \( y_i^* \) are the working response values and \( v_i \) are the weights,

\[
u_i = v_i \exp(z_i^T \hat{\beta})
\]

\[
y_i^* = z_i^T \hat{\beta} + \frac{y_i - \exp(z_i^T \hat{\beta})}{\exp(z_i^T \hat{\beta})}
\]

The regularized Poisson linear model works by first deciding a \( \rho \in [\rho_{\text{min}}, \rho_{\text{max}}] \) lowering sequence, starting with a minimum value \( \rho_{\text{max}} \) such that the entire vector \( \hat{\beta} = 0 \) works. An outer loop for comp \( \ell_Q(\beta) \) at \( \hat{\beta} \) is generated for every value of \( \rho \). Secondly, to solve a penalized least square problem, a regularized technique is used.

\[
\min_{\beta \in \mathbb{R}^p} \Omega(\beta) = \min_{\beta \in \mathbb{R}^p} \left\{ -\ell_Q(\beta) + \sum_{k=1}^{p} \rho_k (|\beta_k|) \right\}
\]

Suppose we’ve got the \( \hat{\beta}_j \) calculation for \( j \neq k \), \( j,k = 1,2, \ldots, q \). The method involved in partially optimizing (2) \( \beta_j \) relates to this

\[
\min_{\beta \in \mathbb{R}^p} \Omega(\hat{\beta}_1, \ldots, \hat{\beta}_j, \ldots, \hat{\beta}_q).
\]

For example in the case, the penalized update by setting \( \gamma \) to 0 or 1 respectively for the adaptive elastic net is

\[
\hat{\beta}_k \leftarrow S\left( z_i z_{ik} \left( y_i - y_i^{(k)} \right), \rho_k \gamma \right)
\]

where \( y_i^{(k)} = \hat{\beta}_i + \sum_{j \neq k} z_{ij} \hat{\beta}_j \) is the fit value excluding the \( z_{ik} \) covariate contribution, and \( S(z, \rho) \) is the operator of soft-thresholding with a value
Update (4) \( k = 1, 2, \ldots, p \) is replicated before convergence occurs. Methods of regularization for penalties are introduced in the \textit{glmnet} R package \([4]\). For (4), \( \gamma = 1 \) set for adaptive lasso, while \( 0 < \gamma < 1 \) set for adaptive elastic net.

3 Method

The spatial data used in this paper are secondary data sourced from Richard Condit et al.’s research on "Complete data from the Barro Colorado 50-ha plot: 423617 trees, 35 years" regarding the location of Beilschmiedia pendula Lauraceae trees, which are located in an area of 50 hectares of forest, tropical rain Island Barro Colorado in Central Panama. Ninety-four covariates data related to environmental factors, consisting of 2 topological attributes, namely elevation and gradient; 13 soil nutrients, namely aluminium, boron, calcium, cooper, iron, potassium, magnesium, manganese, phosphorus, zinc, nitrogen, N(min) and pH; and 79 interactions between 2 soil nutrients and 2 topological points.

The method used in this paper is to estimate the parameters in the inhomogeneous Poisson point process model using the regularized maximum likelihood estimation. In regularized maximum likelihood estimation method, we will also do parameter selection for get the best model. In this method there are \( \gamma \) and \( \rho \) parameters that will be tuned by using two-dimensional BIC. The simulation study will then be carried out with several scenarios. Then we run the regularization method on the case of the Beilschmiedia pendula Lauraceae trees.

4 Result and Discussion

It is really worth noting that penalized procedures depend primarily on the tuning parameters \( \rho \) and \( \gamma \) in the adaptive elastic net, so that the choice of \( \rho \) and \( \gamma \) is also becoming an essential activity. The approximate value of \( \gamma \) from the maximum value of \( \gamma \) is close to 1 in the selection of \( \gamma \) for the adaptive elastic net system and the minimum value for \( \gamma \) is near 0. If the value \( \gamma \) selected is 1, the method switches to the adaptive lasso. In addition, the option of \( \lambda \) for the selected value is verified. The estimate with a huge value of \( \rho \) appears to have smaller variance, but larger biases, whereas the estimate with a small value of \( \rho \) contributes to zero biases, but greater variance. The trade-off between the biases and the variances results in an optimal option of \( \rho \). A range of \( \rho \) values ranging from a maximum value of \( \rho \) , for which all penalized coefficients are zero to \( \rho = 0 \) , is rational for choosing \( \rho \). By fixing a path of \( \rho \) and \( \gamma \), we select the tuning parameter \( \rho \) and \( \gamma \) which minimizes \( BIC(\rho, \gamma) \), defined by

\[
BIC(\rho, \gamma) = -2\log(\beta) + s(\rho, \gamma)\log(W) \tag{5}
\]
where $s(\rho, \gamma) = \sum_{k=1}^{d} 1\{\beta_j(\rho, \gamma) \neq 0\}$ is the number of selected covariates with coefficients of nonzero regression and $|W|$ is the volume of observation describing the sample size.

In simulation study, we make simulation with the spatial domain is $W = [0, 1000] \times [0, 500]$. We centre and scale the 201 × 101 pixel images of elevation ($x_1$) and gradient of elevation ($x_2$) contained in the BPL datasets of spatstat library in R (R Core Team, 2016), and use them as two true covariates. In addition, we create scenarios to define extra covariates. We generate ninety two 201×101 pixel images of covariates as standard Gaussian white noise and denote them by $x_3, \ldots, x_{94}$. We define $z(u)$ as the covariates vector. The regression coefficients for $z_3, \ldots, z_{94}$ are set to zero.

The mean number of points over the domain $W$, $\mu$, is chosen to be 50, 500 and 1500. We set the true intensity function to be 

$$\lambda(\rho, \gamma) = \beta_0 + \beta_1 x_1(u) + \beta_2 x_2(u),$$

where $\beta_1 = 3$ represents a relatively large effect of elevation, $\beta_2 = 0.5$ reflects a relatively small effect of gradient, and $\beta_0$ is selected such that each realization has 50, 500 or 1500 points in average.

With these scenarios, we simulate spatial point patterns from a Poisson point process using the rpoispp function in the spatstat package. For each of the three scenarios, we fit the intensity to the simulated point pattern realizations with 10 looping. In simulation, the regularization methods under the adaptive LASSO (AL) and adaptive elastic net (AENET) penalty were applied. For solving the estimation, the glmnet library in R was used. First for AENET, we choose value of $\gamma$ with $0 \leq \gamma \leq 1$. A quadratic approximation to the negative log-likelihood assessed in the current estimates was then generated for each value of $\rho$. Then, a method of regularization was introduced to solve a problem with penalized least squares. Finally, the $BIC(\rho, \gamma)$ was minimized to obtain $\rho$ and $\gamma$.

Table 1 shows the percentage of selection covariates of the regularization methods under various penalty functions in the simulation performance. The proportion of times when the actual covariates, elevation $x_1$, and gradient $x_2$ were correctly held in the selected model, and the average proportion of times when the noise covariates $x_3$ to $x_{94}$ were correctly selected, are recorded for different $\mu$ values. Although the value of $\mu$ is small, the methods of regularization are not really good for the selected true covariate, but the noise covariate can be selected better than adaptive LASSO.

Table 1 shows the percentage of selection covariates of the regularization methods under various penalty functions in the simulation performance. The proportion of times when the actual covariates, elevation $x_1$, and gradient $x_2$ were correctly held in the selected model, and the average proportion of times when the noise covariates $x_3$ to $x_{94}$ were correctly selected, are recorded for different $\mu$ values. Although the value of $\mu$ is small, the methods of regularization are not really good for the selected true covariate, but the noise covariate can be selected better than adaptive LASSO.

In application, censuses were performed in the 50-hectare area of the tropical moist forest of Barro Colorado Island, resulting in maps of tree species of Beilschmiedia pendula Lauraceae.
[Hubbell et al., 2005]. It is of interest to know how the coexistence of the very large number of different tree species continues. The positions of 3,604 Beilschmiedia pendula Lauraceae (BPL) trees are of special interest to us. As a log-linear function with 2 topological attributes, 13 soil properties and 79 interactions between them as covariates, we model the intensity of BPL trees. To pick and estimate parameters, we apply the regularized Poisson probability with comparisons between adaptive LASSO and adaptive elastic net. Notice that all the covariates are based to observe which covariates have a relatively large impact on the intensity.

Table 2. Number of selected and non-selected covariates among 94 covariates

<table>
<thead>
<tr>
<th>Method</th>
<th>Covariate Selected</th>
<th>Covariate Non selected</th>
<th>BIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL</td>
<td>56</td>
<td>37</td>
<td>40011.3</td>
</tr>
<tr>
<td>AENET</td>
<td>58</td>
<td>35</td>
<td>40019.3</td>
</tr>
</tbody>
</table>

Table 2 showed the number of covariates selected and not selected by each process. Regarding the method of regularization, the method of regularization with adaptive lasso selects 56 covariates. There are 58 covariates chosen in contrast to the adaptive elastic net methods. This implies that when the regularized Poisson probability is applied, adaptive LASSO selection and adaptive elastic net work almost equally.

5 Conclusion

Based on Poisson likelihood, we create regularized maximum likelihood estimation versions of estimating equations for estimate and select the parameter. For modeling the intensity of inhomogeneous Poisson point processes, our procedure may conduct covariate selection along with estimating it. We research the tuning parameter $\rho$ and $\gamma$ in adaptive elastic net method using BIC can make regularized Poisson likelihood estimates more optimal than other regularization method.

In the simulation analysis, we carry out certain different parameters to observe the selection and prediction properties of the estimates. From the findings, we suggest applying the regularized Poisson likelihood combined with adaptive elastic net with tuning parameter when dealing with covariates that have a complex covariance matrix and when the point pattern looks very clustered. In its application to tree species of Beilschmiedia pendula Lauraceae data location, the regularized Poisson likelihood combined with adaptive elastic net with tuning parameter can estimate coefficient covariate and choose the best covariate who have significant impact for the existence of a Beilschmiedia pendula Lauraceae tree species in the 50-hectare area of the tropical moist forest of Barro Colorado Island.

References


The Effect of Flashcards on Students in Writing Vocabulary at Seventh Grade of MTs Al Ulum

Nurhalimah¹, Sumarsih², Rahmad Husein³
{nhalimahhalimah227@gmail.com¹, prof.sumarsih@gmail.com², rhnapitupulu@yahoo.com³}

Doctoral Programs in English Applied Linguistics in English Applied Linguistic Study Program, Universitas Negeri Medan, Medan, Indonesia¹, Postgraduate in English Applied Linguistic Study Program, Universitas Negeri Medan, Medan, Indonesia²,³

Abstract. This study was examined students writing vocabulary by using flashcards; the method is a qualitative and quantitative method, where the data collected and analyzed through statistical analysis. The type of research was experimental research. And the students will give a pretest to find their vocabulary before being given treatment. After that, we're given a post-test toward their language. In the seventh grade of MTs Al Ulum Medan, the populations of this research were students. The large number was limited that 20 students were chosen as the sample. This method aims to train the right brain's ability to recall images and words so that the students' vocabulary and writing skills can be taught and improved. And the result showed that the treatment of the students in writing vocabulary is an increase. It can be seen from the resulting test after treatment. It means flashcards are suitable for improving students' writing skills, especially for seventh-grade students who beginners level in English.

Keywords: Writing, Vocabulary, and Flashcard.

1 Introduction

The fundamental function of language is an instrument of communication. English is used by millions of people all over the world. In Indonesia, English is considered a foreign language taught to be elementary school up to university. In the education aspect, the students hope to speak and write in English to technology development. Teaching English in the junior high school (SMP) curriculum covers four skills: reading, listening, speaking, and writing. Writing is part of language skills and an enjoyable practice since the definition can be completely articulated in either as a document of an event in history or as a statistical analysis, a paper document by anyone. In communicating a language, writing has significance as a means of communication. It is possible to convey meaning by hand because it is a tool in a written organizational system. Byrne [1] He suggested that we use graphic symbols when we write: letters or letter combinations that refer to the sounds we make when we write. In fact, this idea will explain the writer's opinions, emotions, interests, and feelings, and one is so used to writing would be able to discover his distinctive personality inside himself and convey it.

While To each of us, writing is important, particularly for students, it is a complicated discussion. The interpretation is that, in particular, writing is a combination of our thoughts, grammar, and vocabulary. It is the responsibility of the teacher to encourage learners to react to specific grammatical errors in their own written discourse in their passive grammatical
knowledge and develop lexical accuracy techniques and expand the academic vocabulary. Vocabulary is one of the essential elements of language that can be produced by the learner. Having a lot of speech will allow the students to make the phrases and ultimately lead them to develop contacts. It is, therefore, quite important to learn a great deal of English vocabulary to acquire communication skills. Sometimes, language is more important than grammar. Learning that they cannot interact effectively is frustrating for intermediate students because they do not know all of the terms they need [2].

A selection of words requires vocabulary. Words are not only recognized as individual words but also as a group of meaningful words. To improve students' language skills in reading, listening, speaking, and writing, they need to have certain levels of vocabulary. David Nunan [3] stated, "The vocabulary learning has acquired its proper position as the critically important component of language learning." It is assumed that someone should have the stock of vocabulary to develop their English. The teachers may employ specific strategies to optimize classroom activities, such as using appropriate approaches concerning the students' characteristics to get bored quickly. It is essential to consider what kind of process can be used to make English for young students to become comfortable and exciting. To get the students' attention, it is necessary to create a class situation that can motivate the students to study.

One of the ways to create the class more interesting is through media. Meriam stated that "Flashcard is a card bearing words numbers of pictures that are briefly displayed (as by a teacher to a class) usually as a learning aid." Flashcards are widely used as a learning drill to aid memorization by way of spaced repetition. Flashcards are an exciting media that will inspire students. Flashcards can be used to explain the meaning and construction of the language, to engage students in the subject, or as a basis for all activities. Concerning that, there are many ways of using writing vocabulary. So, from the explanation, the writer wants to find the effects of using flashcards on the students' writing vocabulary.

2 Materials

2.1 Writing

Communication is crucial in this modern age, and so many of us need to connect with each other, even though we are far distance. And, of course, it is generally recognized that the medium of writing has successfully become a language of international communication. One of the often required communication skills in writing. Speaking and listening, however, take up a significant proportion of time human beings spend in conversation, writing, which is a more complex method for most people to demand than talking. When speaking and listening start early in the life of the kid.

Writing ability can be described as the ability to express ideas through written symbols by arranging the arguments to convey the following on the basis of the rules of the Language system to allow others to understand the written message. These abilities include: (1) the learn how to write a word; (2) the ways of organizing words into sentences; (3) the writing a phrase; (4) the ability to construct a paragraph; and (5) the knowledge to implement a long text.

a. David Nunan[4] claimed that it involved good writing:
   b. Mastering the letter shape mechanic,
   c. Mastering and obeying spelling, vocabulary, and punctuation conventions,
   d. Using the grammatical system to express the expected significance of one,
2.2 Vocabulary

According to Penny [5], "Vocabulary can be defined, roughly, as the words we teach in the foreign language." A new vocabulary item, however, can be more than a single word: handphone and mother-in-law, for example, consisting of two or three words but communicating a conceptual model.

2.2.1 Principles for Teaching Vocabulary

Learners see vocabulary as being an essential part of language learning, and one of the difficulties in planning the vocabulary component of the course is making sure that it does not overwhelm other critical factors in the system. The best way to avoid this is for the teacher and course designer to have a set of guiding principles that can be applied in various teaching and learning situations by David Nunan. They are:

a. Focused on the most useful vocabulary first.
   The most useful vocabulary that every English language learner needs, whether they use the language for listening, speaking, reading, or writing, or using the language in formal and informal situations, is the most frequent 1000 words families of English. This vocabulary is so useful that it covers around 75 percent of the running words in academic texts and newspapers, over 80 percent of the running words in novels, and about 85 percent of the running world in conversation. It involves most of the 176 families of function words (a story like a, since, could) and words such as hold, kind, knowledgeable, lack, and ground. It is possible to say and write a lot using only the first 1000 words of English.

b. Focus on the vocabulary in the most appropriate method
   There are four main learning strategies for vocabulary: using word elements, guessing meaning, Term cards are being used, and dictionaries will be used. One of the appropriate processes for children is using word cards; they memorize new words.

c. Give attention to the high-frequency words; the four strands of a course's high-frequency vocabulary needs to occur in all for strands of course. It should get deliberate attention through teaching and study and be met and used in communication messages in listening, speaking, reading, and writing. High-frequency vocabulary for receptive and productive use should also be accessible fluently.

d. Encourage learners to reflect and take responsibility for learning.
   Behind choice and learning, there is a significant philosophy, And that is, students need to recognize that they'll have to be responsive for their training. Take this task includes:
   1. Knowledge of where to practice and the selection of learning vocabulary tools.
   2. Ability in choosing the best option.
   3. The ability to monitor and evaluate progress with those options.

In accordance with the approach and the media they use, this idea must be grasped by students.
2.2.2 Element to be taught in Vocabulary

In vocabulary instruction, Penny needs to be educated a lot of them; they are:

a. Form: pronunciation and word order
   The learner must understand what a word (its pronunciation) sounds like and what it looks like (its pronunciation) and what it looks like (it is the spelling). We need to make sure that all these things are addressed and learned correctly.

b. Grammar
   For example, when teaching a new verb, we might also its part form if this is irregular (think, though), and we might note if it is transitive. Similarly, when teaching a noun, we may wish to present its plural form, if irregular (mouse, mice), or draw the learner's attention because It does not have a plurality in anyway, (advice, Knowledge information).

c. Collocation
   Another aspect that makes one specific arrangement appear 'right' or 'wrong' in a particular context is the pronouns typical of specific items. So this is another piece of knowledge which might be necessary to teach about such a specific element.

d. The significance component: referent, subtext, adequacy
   The interpretation of the word in the actual world, its referent, is essentially what something applies to; that was also the sort of description provided in a vocabulary. A dog indicates some kind animal, for course. "Connotation is the associations, or positive or negative feelings it evokes, which may or may not be indicated in a dictionary definition." The word dog, for example, has a positive connotation of friendship and loyalty, as known by most British people. In comparison, As the amount of respondents in Arab countries recognize, the equivalent in Arabic has positive correlations with dirt and inferiority.

How its relevance of one element applies to the relevance of the others also might be important in teaching. There are distinguished connections such as this one: most of the other primary places are already here.

1. Synonymy
   Points which represent the same and the mostly the same; bright, imaginative, intelligent, for instance, It can serve as a synonym for knowledgeable.

2. Antonyms
   Things which indicate the opposite; a weak antonym is large.

3. Hyponyms
   Items that serve as particular examples of a general definition are the animal hyponyms, dog, lion, mouse.

4. Co-hyponymy
   The 'same sort of thing' or examples are other items; Red, blue, green, and brown are perfect.

5. Super ordinates
   Common principles that encompass particular things; the animal is the dog's superior, the lion's mouse.

6. Translation
   Phrases in the mother tongue of the learners that are (more or less) similar in understanding to the knowledge given.

7. Formation of Terms
In teaching vocabulary, the teacher also needs to explain the process of prefixes and suffixes.

2.3 Flashcards

Usman [6] states, 'Media is an intermediary used to relay messages and to encourage the public (students)’ thinking, feeling and success in facilitating the learning process.’ Media means intermediary or presentation. Media are all modes that are designed to channel information transmission, according to the Association for Education and Communication Technology (AECT) [7].

The media will improve the learning process of students, and the subject matter submitted to the teacher would be quicker and easier to understand. Adding visuals to a lesson improves retention from 14 to 38 percent, according to Silberman [8]. When vocabulary is taught using visual aids, studies have also shown an increase of up to 200 percent. One of the visual aids used in memorizing new words is introduced by Glenn Doman, a brain surgeon from Philadelphia, Pennsylvania. The flashcards’ pictures are grouped among others be: a series of animals, fruits, and clothing. Children play a color form of numbers and so forth, Flashcards; it is appropriately read, just in time 1 second for each card by Arseto [9].

Flashcards that have pictures and words would be one exciting medium in teaching vocabulary. So, a learner is busy with learning and memorizing activities that sometimes make the learners get boring. Still, it can also make the students comfortable in playing but was able to learn new vocabulary.

There are strategies for using flashcards in writing vocabulary; they are:

1. Practice Important Question: Application 1: Materials; flashcards, sheets of blank paper
   Show flashcard questions and ask participants to speak with a response or show responses and ask them questions. They can also ask the students to write down the question or answer. Setting up question flashcards around the room and asking students to go to each one and write down an answer to the question is another alternative.

2. Write Stories or Sentences Application 2: Materials: flashcards, blank paper sheets
   Send student groups a set of different flashcards of words or pictures. Ask them to develop a creative way to use them all in a sentence, write questions, make true or false statements, or write a novel using the vocabulary of the cards. Make their sentences, questions, or plot clarified by the learners. Try to have the students write the logical or illogical term the flashcard uses for the longest possible time. Distinguish between supporting more accomplished students to take on the story-writing challenge while encouraging others to write statements or questions.

3. Application 3: Define an Image: Materials: flashcards, blank paper sheets
   Send students a calendar image or another image that has a scene. Ask them to write a story that goes with it, ask questions about the idea, give the image a title, or write a mix of reasonable and nonsensical statements about it to clarify the image.

   They are using alphabet flashcards to get people or groups to brainstorm a list of all the terms they know that begin with the letter. Have them do this by going through a few stations with various letters or receiving three to four random letters. See how long they can form a sentence, where all the words start with the same letter, as an additional challenge.
Focus on providing students in group pairs with a few unrelated flashcards and ask them to write words, questions, or stories that create a connection between them. Ask learners also to have an example.

6. Application 6: Seeking Fairy Tales Inspiration: Materials: flashcards, sheets of blank paper
To inspire fairy tales that children can write, use decks of cards such as Old Maid, Go Fish, and other matching games as a graphic source.

7. Application 7: Games for Play: Material: Flashcards
To play around the world, use flashcards, Five, Charades, Pictionary, Inside-Out Circle activities, and question-answer game. But in this research, the writer used flashcards in a question-answer game as application seven above. "The age of students is a major factor in teacher's decisions about how, what to teach, and what strategy that wants to use in the learning." We might expect students of primary age to acquire new vocabularies through play, using visual media, and fun activities for people with different needs, competencies, and cognitive skills. Especially for students in the SMP grade, optical media (such as flashcards) in a game is one of the best teaching strategies to motivate them in learning vocabulary.

3 Method

3.1 Concept of Analyses

The method of analysis included in this analysis was the qualitative method, where the data was collected and analyzed through statistical analysis. The type of research was experimental of research. In this research, the writer wanted to examine the influence of using flashcards on the comprehension of students' written vocabulary. In this research, the students were given a pretest to see their vocabulary before being given treatment. After treatment, a post-test to assess the validity of the experiment on their language has been provided to the students.

3.2 The Analysis and Populace

The target population comprised seventh-grade learners of MTs Al ulum Medan. This class is made up of 20 students. The seventh grade of the MTs Alul Medan consists of 12 females and 8 males. According to Arikunto [10], "Population is a set or collection of all elements processing one or more attributes of interest." The population of this research was students in the seventh grade of MTs S Al ulum Medan. For the efficiency and practicality of this research, the large number of the sample was limited. Arikunto said that "if the population is similar to one hundred students, we can take them all as the sample." In this research, 20 students were chosen as the sample.

3.3 Instrumentation
In this research, the test was used as an instrument. The students were given a test to know and get the data about students writing vocabulary that consists of 40 questions. The test was multiple-choice tests with four alternatives a, b, c, d. The students were given time 45 minutes. If the students can answer all the questions correctly, the score was 10. It means that the correct answer will be given a score of 0, 25, while the wrong answer will be provided.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Items No.</th>
<th>Items Score</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts of School</td>
<td>6</td>
<td>1-7</td>
<td>15.0</td>
</tr>
<tr>
<td>Parts of House</td>
<td>7</td>
<td>7-13</td>
<td>17.5</td>
</tr>
<tr>
<td>Parts of Body</td>
<td>7</td>
<td>14-20</td>
<td>17.5</td>
</tr>
<tr>
<td>Classroom Object</td>
<td>7</td>
<td>21-27</td>
<td>17.5</td>
</tr>
<tr>
<td>Family</td>
<td>6</td>
<td>28-33</td>
<td>15.0</td>
</tr>
<tr>
<td>Jobs and the Responsibilities</td>
<td>7</td>
<td>34-40</td>
<td>17.5</td>
</tr>
<tr>
<td>Total Score</td>
<td></td>
<td></td>
<td>100.00</td>
</tr>
</tbody>
</table>

3.4 Data collection techniques

The writer collected it by giving a test in order to obtain the data. The test is some of the questions used to measure skills, knowledge, and intelligence. The trial divided into two kinds: they are:

a. Pretest
   Before the treatment, a pretest would be given to the students. It would be aimed to measure the students' skill in writing vocabulary before applying for the test.

b. Post-test
   After conducting the treatment, a post-test was given to the students. Posttest is the same as Pretest. The post-tests administrating was mean to find out the differences in score before and after the treatment.

3.5 The Procedure of the Research

In conducting the research, the writer took the following step:
The study was done by observing the seventh grade of MTs Al Ulum Medan as the research object, then set the research and prepared test.

a. The writer gave Pretest to the students to know their achievement in writing vocabulary.

b. You are explaining vocabulary by using flashcards to the students.

c. The writers gave them a post-test after giving the treatment to assess their writing after receiving the treatment.

d. From the analysis of the data, the writer takes the conclusion.

3.6 Data Processing Methodology
In this research, qualitative data were also used. The qualitative information from the observation and the quantitative data from the written vocabulary examination of the students. The following formula was applied: Identify the student's average points.

\[ \bar{X} = \frac{x}{N} \]

Where: \( \bar{X} \) = The total points for the learners
\( x \) = Complete Having scored
\( N \) = The cumulative amount of students in the program course.

4 Result and Discussion

4.1 Data

To evaluate the effect of using flashcards on students' writing vocabulary, the writer has calculated the data by Pretest and post-test. Next, the writer described the data as follow:

4.1.1 Data Pretest

<table>
<thead>
<tr>
<th>No</th>
<th>Students' Initial Name</th>
<th>Correct Score</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SG</td>
<td>22</td>
<td>4.40</td>
</tr>
<tr>
<td>2</td>
<td>ST</td>
<td>25</td>
<td>5.0</td>
</tr>
<tr>
<td>3</td>
<td>VA</td>
<td>10</td>
<td>2.0</td>
</tr>
<tr>
<td>4</td>
<td>RDU</td>
<td>18</td>
<td>3.6</td>
</tr>
<tr>
<td>5</td>
<td>HZ</td>
<td>24</td>
<td>4.8</td>
</tr>
<tr>
<td>6</td>
<td>DM</td>
<td>11</td>
<td>2.2</td>
</tr>
<tr>
<td>7</td>
<td>ZAF</td>
<td>12</td>
<td>2.4</td>
</tr>
<tr>
<td>8</td>
<td>AL</td>
<td>20</td>
<td>4.0</td>
</tr>
<tr>
<td>9</td>
<td>SR</td>
<td>15</td>
<td>3.0</td>
</tr>
<tr>
<td>10</td>
<td>ESY</td>
<td>14</td>
<td>2.8</td>
</tr>
<tr>
<td>11</td>
<td>DL</td>
<td>20</td>
<td>2.4</td>
</tr>
<tr>
<td>12</td>
<td>NR</td>
<td>18</td>
<td>3.6</td>
</tr>
<tr>
<td>13</td>
<td>DA</td>
<td>16</td>
<td>3.2</td>
</tr>
<tr>
<td>14</td>
<td>FR</td>
<td>15</td>
<td>3.0</td>
</tr>
<tr>
<td>15</td>
<td>DW</td>
<td>7</td>
<td>1.4</td>
</tr>
<tr>
<td>16</td>
<td>SK</td>
<td>15</td>
<td>3.0</td>
</tr>
<tr>
<td>17</td>
<td>LT</td>
<td>16</td>
<td>3.2</td>
</tr>
<tr>
<td>18</td>
<td>RR</td>
<td>12</td>
<td>2.4</td>
</tr>
<tr>
<td>19</td>
<td>AG</td>
<td>12</td>
<td>2.4</td>
</tr>
<tr>
<td>20</td>
<td>WY</td>
<td>12</td>
<td>2.4</td>
</tr>
</tbody>
</table>

The performance value of learners in Pretest It is shown in the section following table:

Table 3. The percentage of Average of both the students during Pretest
Table 4. The class proportion in writing vocabulary in Pretest

<table>
<thead>
<tr>
<th>Category</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high</td>
<td>-</td>
<td>%</td>
</tr>
<tr>
<td>High</td>
<td>-</td>
<td>%</td>
</tr>
<tr>
<td>Enough</td>
<td>4</td>
<td>20%</td>
</tr>
<tr>
<td>Low</td>
<td>15</td>
<td>75%</td>
</tr>
<tr>
<td>Very low</td>
<td>1</td>
<td>5%</td>
</tr>
</tbody>
</table>

They range from very high, high, appropriate, low, and very low, respectively. It has been shown that there is a student who is sufficiently classified (20%) and low sort (75%), the students who have deficient variety one student (5%), so in Pretest the students' score in writing vocabulary have a common type.

4.1.2 Data Post-Test

Table 5. Students’ Post-Test Value

<table>
<thead>
<tr>
<th>No</th>
<th>Students’ Initial Name</th>
<th>Correct Score</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SG</td>
<td>36</td>
<td>7.2 High</td>
</tr>
<tr>
<td>2</td>
<td>ST</td>
<td>37</td>
<td>7.4 High</td>
</tr>
<tr>
<td>3</td>
<td>VA</td>
<td>30</td>
<td>6.0 Enough</td>
</tr>
<tr>
<td>4</td>
<td>RDU</td>
<td>31</td>
<td>6.2 High</td>
</tr>
<tr>
<td>5</td>
<td>HZ</td>
<td>36</td>
<td>7.2 High</td>
</tr>
<tr>
<td>6</td>
<td>DM</td>
<td>28</td>
<td>5.6 Enough</td>
</tr>
<tr>
<td>7</td>
<td>ZAF</td>
<td>30</td>
<td>6.0 Enough</td>
</tr>
<tr>
<td>8</td>
<td>AL</td>
<td>33</td>
<td>6.6 High</td>
</tr>
<tr>
<td>9</td>
<td>SR</td>
<td>28</td>
<td>5.6 Enough</td>
</tr>
<tr>
<td>10</td>
<td>ESY</td>
<td>26</td>
<td>5.2 Enough</td>
</tr>
<tr>
<td>11</td>
<td>DL</td>
<td>35</td>
<td>7.0 High</td>
</tr>
<tr>
<td>12</td>
<td>NR</td>
<td>33</td>
<td>6.6 High</td>
</tr>
<tr>
<td>13</td>
<td>DA</td>
<td>28</td>
<td>5.6 Enough</td>
</tr>
<tr>
<td>14</td>
<td>FR</td>
<td>30</td>
<td>6.0 Enough</td>
</tr>
<tr>
<td>15</td>
<td>DW</td>
<td>25</td>
<td>5.0 Enough</td>
</tr>
<tr>
<td>16</td>
<td>SK</td>
<td>29</td>
<td>5.8 Enough</td>
</tr>
<tr>
<td>17</td>
<td>LT</td>
<td>28</td>
<td>5.6 Enough</td>
</tr>
<tr>
<td>18</td>
<td>RR</td>
<td>30</td>
<td>6.0 Enough</td>
</tr>
<tr>
<td>19</td>
<td>AG</td>
<td>29</td>
<td>5.8 Enough</td>
</tr>
<tr>
<td>20</td>
<td>WY</td>
<td>31</td>
<td>6.2 High</td>
</tr>
</tbody>
</table>

The number of post-test academic performance can be seen from the present study:
Table 6. Amount of Pretest Class Rating

<table>
<thead>
<tr>
<th>No</th>
<th>X</th>
<th>Xi</th>
<th>Fi</th>
<th>Fi, xi</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.5 – 7.4</td>
<td>6.95</td>
<td>6</td>
<td>41.7</td>
<td>30%</td>
</tr>
<tr>
<td>2</td>
<td>5.5 – 6.4</td>
<td>5.95</td>
<td>12</td>
<td>71.4</td>
<td>60%</td>
</tr>
<tr>
<td>3</td>
<td>4.5 – 5.4</td>
<td>4.95</td>
<td>2</td>
<td>9.9</td>
<td>10%</td>
</tr>
<tr>
<td>4</td>
<td>3.4 – 4.4</td>
<td>3.95</td>
<td>-</td>
<td>-</td>
<td>%</td>
</tr>
<tr>
<td>5</td>
<td>2.5 – 3.4</td>
<td>2.95</td>
<td>-</td>
<td>-</td>
<td>%</td>
</tr>
</tbody>
</table>

Table 7. The percentage of Students in writing vocabulary in post-Test

<table>
<thead>
<tr>
<th>Category</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high</td>
<td>-</td>
<td>%</td>
</tr>
<tr>
<td>High</td>
<td>8</td>
<td>40%</td>
</tr>
<tr>
<td>Enough</td>
<td>12</td>
<td>60%</td>
</tr>
<tr>
<td>Low</td>
<td>-</td>
<td>%</td>
</tr>
<tr>
<td>Very low</td>
<td>-</td>
<td>%</td>
</tr>
</tbody>
</table>

The table above ranges from very high, high, enough, low, and very low. It can be seen that if a student comes into a very high category (40%), the students who enough type are 12 students (60%), there is no student in the low class and deficient category.

According to Riduwan, the students; the identification of the result should always be described in the result section:

Table 8. The Average Identification of Candidates

<table>
<thead>
<tr>
<th>Score</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>81 – 100</td>
<td>Very high</td>
</tr>
<tr>
<td>61 – 80</td>
<td>High</td>
</tr>
<tr>
<td>41 – 60</td>
<td>Enough</td>
</tr>
<tr>
<td>21 – 40</td>
<td>Low</td>
</tr>
<tr>
<td>0 - 20</td>
<td>Very low</td>
</tr>
</tbody>
</table>

(Resource: Riduwan, Belajar Mudah Penelitian Untuk Guru, Karyawan dan Peneliti Paula)

In this research, it was found that the students' writing vocabulary was weak. They can't express their idea in writing because of a lack of vocabulary. The writer gave them Pretest before treatment; most of the students cannot answer the questions. After doing the observation, the writer found the problem. A strategy used in teaching vocabulary is boring, so the motivation of students to learn English, especially in the language, is poor. The writer attempted to offer the treatment by using flashcards from the issue. Flashcards are the picture cards that have the words introduced by Glenn Doman, a brain surgeon from Philadelphia, Pennsylvania. The pictures on flashcards categorized, among others, the series of parts of the body, parts of the school, parts of the house, classroom objects, Family words, and kinds of occupations. The cards are played in a way shown to the children and read quickly, in just 1 second for each card. This method aims to train the right brain o recall images and words so that students' vocabulary and writing skills can be taught and improved.
The result of the treatment on students in writing vocabulary is increasing. After treatment, from the post-test outcomes, that can be seen. It means flashcards are suitable for improving students' writing language skills, especially for seventh-grade students who beginners level in English subject.

4 Conclusion

That one was discovered that flashcards could get the reading instruction vocabulary since collecting the results. It can be seen from the score of the student before and after treatment. The students' total score in writing speech in the present was 59.45; it is lower than the students' score in writing vocabulary either through the post-test. The students' total points in the post-test was 122.6. So, the research results are flashcards have a significant effect on students' writing vocabulary and could help the students increase their language.

Acknowledgments. The authors thank the Universitas Department of Postgraduate in English Applied Linguistic Study Program, State University of Medan/Unimed, to encourage and facilitate the authors to complete this research.

References

[1] Byrne D 1979 Teaching Writing Skill (Singapore: Longman) p 1
[8] Silberman M 1996 Active Learning: 101 Strategies to Teach Any Subject Allyn and Bacon p 2
BR+ for Addressing Imbalanced Multilabel Data Classification Combined with Resampling Technique

Nilam Novita Sari¹, Ismaini Zain², Kartika Fithriasari³, Amri Muhaimin⁴
{ninanovitasari2013@gmail.com¹, ismaini_z@statistika.its.ac.id², kartika_f@statistika.its.ac.id³}

Department of Statistics, Faculty of Science and Data Analytics, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia¹,²,³,⁴

Abstract. BR+ is a multilabel method that transforms multilabel into binary single label and assumes label dependency. BR+ can use any different classification method such as random forest. Random forest is an advantageous classification method. But presence of imbalanced classes, random forest will result in poor performance. Hence, handling imbalanced data can be done by applying resampling techniques consisting of SMOTE-NC and T-Link. The dataset used was adolescent risk behavior of drug abuse and premarital sex based on SKAP. The dataset has two labels means there are multilabel problems and the dataset is imbalanced. Thus, the combination of BR+ (Stat) and resampling techniques will be compared in handling multilabel imbalanced data in the classification of adolescent risk behavior using random forest. The results show that the optimum Mtry is 7 and the combination of BR+ (Stat) and T-Link is the best method to handle the multilabel imbalanced data.

Keywords: Multilabel Imbalanced Data, BR+, SMOTE-NC, Tomek Link, Random Forest

1 Introduction

Classification is the process of finding a model that describes and distinguishes data classes or concepts used to predict the class label of objects for which the class label is unknown [1]. In general, classification is usually used for a single-label problem where each instance is associated with a class label from a set of disjoint labels \( |\mathcal{L}| \). However, sometimes each instance is associated with more than one class, which is called multilabel. Problem Transformation (PT) method is one way to solve the multilabel problem because of the flexibility of the Problem Transformation. PT is a method that transforms the multilabel classification into one or more single label [3]. Several PT methods are often used such as binary relevance (BR). BR is extended to BR+ to overcome the limitation of BR. BR+ is a method that transforms multilabel into \( |\mathcal{L}| \) number of the binary single label and assumes label dependency. There are three ways to do BR+, which are BR+ NU (No Update), BR+ Stat (Static Order), and BR+ Dyn (Dynamic Order). The difference between the three methods is in the prediction phase. The Transformation Problem methods such as BR, CC, and BR+ were compared by [4] using SVM, J48, and Naïve Bayes (NB) as the base classifier. BR+ (Stat) and BR+ (Dyn) transformation have the best performance using J48 and NB, while for SVM, the best performance is obtained using the CC transformation method. BR+ can use any classification method such as random forest.
Random forest is one of the decision tree methods. Random forest is a group of un-pruned decision trees made from the random selection in samples of the training data and then the prediction is made by aggregating (majority vote for classification) the predictions of the trees [5]. Random forests have some advantages, such as the ability to handle thousands of variables without deletion or deterioration of accuracy, its speed and ease of implementation, accuracy of prediction results produced, etc. [6,7]. Random forest is considered to be one of the most accurate techniques available [8]. Although random forest has some advantages, just like other classification methods, random forest faced problems when the dataset is imbalanced. For an imbalanced dataset, most of the classification algorithms tend to produce a high accuracy rate for the majority class and produce a low prediction rate for the minority class with a low accuracy rate.

An imbalanced dataset is a condition where fewer training instances exist in one class (minority class) than another class (majority class) [8]. An imbalanced dataset will result in poor performance because it produces low accuracy in the minority class. Resampling approaches can be used to solve this problem. Resampling approaches are techniques that rebalance the distribution of data. Resampling approaches are divided into three categories which are over-sampling, under-sampling, and hybrid sampling.

Random over-sampling approach duplicates the minority samples so that the instances in the minority class equal the instances in the majority class. One of the most popular random over-sampling methods is SMOTE (Synthetic Minority Over-sampling Technique). SMOTE is a method that creates “synthetic” instances in the minority class [9]. SMOTE can be extended to SMOTE-NC to handle mixed datasets of continuous and nominal features. Random under-sampling is another way to deal with imbalance problems by removing some instances in the majority class to balance the distribution of datasets [10]. The advantage of the under-sampling method is that it can reduce the size of the data by eliminating some instances and decreasing the run-time cost especially in the case of big data [11]. One of the under-sampling methods is Tomek Link (T-Link). T-Link can be used as an under-sampling method which removes instances in the majority class or as a cleaning method to remove noise. Another resampling technique is hybrid sampling. Hybrid sampling is the combination of over-sampling and under-sampling approaches used to make the dataset more balanced and it can improve the accuracy of classification performance. SMOTE+T-Link is one of the hybrid sampling methods used to clean data. SMOTE, Tomek Link, and SMOTE+TL were compared by [12] using SVM as the base classifier. The results of this study show that hybrid sampling SMOTE+TL has better performance than using only SMOTE or Tomek Link, but in the case of extreme data imbalance (minority class less than 10%), the SMOTE+TL is no better than using Tomek Link. Then, in 2016 [11] used different imbalanced method and different classification methods to compare their effectiveness in addressing the imbalance data issue and the results show that the combination of SMOTE+TL and RUS+TL have the best performance as compared to other sampling methods.

In this paper, we will compare the classification of the multilabel imbalanced data using random forest with different parameter tuning and we propose BR+ Stat to solve the multilabel problem and combine it with resampling techniques which are SMOTE-NC, T-Link, and a combination of SMOTE-NC and T-Link (SMOTE-NC+TL) to handle imbalanced data to find the best method to classify the multilabel imbalanced data.
2 Research Method

2.1 Data

The multilabel imbalance data used in this research was the adolescent risk behavior consisting of drug consumption as the label 1 and pre-marital sex as the label 2 based on SKAP (Survei Kinerja dan Akuntabilitas Program KKBP) of East Java in 2019 by BKKBN. The adolescent risk behavior has 5300 instances.

2.2 Research Variables

The variables used in this research are as follows:

\( Y_1 = \) drug consumption (0 = No, 1 = Yes)
\( Y_2 = \) having pre-marital sex (0 = No, 1 = Yes)
\( X_1 = \) age (0 = < 19 years old, 1 = \( \geq \) 19 years old)
\( X_2 = \) sex (0 = Male, 1 = Female)
\( X_3 = \) education (0 = did not go to school or has completed either elementary or junior high school, 1 = completed either senior high school or college education)
\( X_4 = \) domicile (0 = urban, 1 = rural)
\( X_5 = \) knowledge of drugs (0 = no, 1 = yes)
\( X_6 = \) knowledge of the physical consequences of the drug (0 = no, one = yes)
\( X_7 = \) knowledge of the psychological consequences of the drug (0 = no, one = yes)
\( X_8 = \) knowledge of the socioeconomic consequences of the drug (0 = no, one = yes)
\( X_9 = \) knowledge of adolescent sexual and reproductive health (ASRH) (0 = no, 1 = yes)
\( X_{10} = \) knowledge of women’s fertility (0 = no, 1 = yes)
\( X_{11} = \) knowledge of pregnancy (0 = no, 1 = yes)
\( X_{12} = \) knowledge of women’s marriageable age (0 = \( \geq \) 21 years old, 1 = others)
\( X_{13} = \) knowledge of men’s marriageable age (0 = \( \geq \) 25 years old, 1 = others)
\( X_{14} = \) knowledge of the consequences of early marriage (0 = no, 1 = yes)

2.3 Research Design

The classification in this study is using random forest and the transformation problem method is using BR+ (Stat). In this research, we try to classify the data using BR+ (Stat) with the order \( y_1 \prec y_2 \) and \( y_2 \prec y_1 \) with the combination of SMOTE-NC, T-Link and SMOTE-NC+T-Link. The random forest modelling uses parameter tuning. The numbers of “M try” that are used here are 2, 4, and 7, and the numbers of the tree used are 50, 100, 250, and 500 trees.
The multilabel imbalanced data are partitioned into training and testing data using 5-fold cross validation. The performance measures used here are accuracy, sensitivity, specificity, precision, macro f-measure and hamming loss. The multilabel imbalanced classification process consisted of several stages as seen in Figure 1.

![Flowchart Research](image)

**Fig. 1. Flowchart Research**

### 3 Results and Discussion

The dataset has extremely imbalanced data the data in minority class are less than 5% for both labels, where in label 1 the minority class is 3.62% and for label 2 the minority class is 0.28%. The results are shown in the following Table.

<table>
<thead>
<tr>
<th>$j_1$</th>
<th>$j_2$</th>
<th>Accuracy</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Precision</th>
<th>F-Measure</th>
<th>N Tree</th>
<th>M Try</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8692</td>
<td>0.9981</td>
<td>0.9444</td>
<td>0.8667</td>
<td>0.9254</td>
<td>50</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.8727</td>
<td>0.9975</td>
<td>0.9777</td>
<td>0.8708</td>
<td>0.9275</td>
<td>100</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.8740</td>
<td>0.9975</td>
<td>0.9956</td>
<td>0.8721</td>
<td>0.9286</td>
<td>250</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.8726</td>
<td>0.9975</td>
<td>0.9943</td>
<td>0.8707</td>
<td>0.9275</td>
<td>500</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.9306</td>
<td>0.9973</td>
<td>0.1548</td>
<td>0.9309</td>
<td>0.9625</td>
<td>50</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.9324</td>
<td>0.9977</td>
<td>0.1586</td>
<td>0.9324</td>
<td>0.9635</td>
<td>100</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.9303</td>
<td>0.9974</td>
<td>0.1562</td>
<td>0.9305</td>
<td>0.9623</td>
<td>250</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1 shows the performance of random forest with BR+ (stat) when SMOTE-NC is applied. The M try 7 is the optimum parameter for the optimum model for both orders. The number of trees for the optimum model for order \( y_1 < y_2 \) is 500 trees while for order \( y_2 < y_1 \) is 100 trees. The classification using SMOTE-NC as a method of handling the imbalance is produced good model. Because the model produces high accuracy, sensitivity, precision, F-Measure. Also, increase the specificity, which is mean that the model with SMOTE-NC can capture data in the minority class.

**Table 2. Performance of BR+ (Stat) using Tomek Link**

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Precision</th>
<th>F-Measure</th>
<th>N Tree</th>
<th>M Try</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9308</td>
<td>0.9973</td>
<td>0.1566</td>
<td>0.9311</td>
<td>0.9626</td>
<td>500</td>
<td>4</td>
</tr>
<tr>
<td>0.9623</td>
<td>0.9979</td>
<td>0.2412</td>
<td>0.9632</td>
<td>0.9801</td>
<td>50</td>
<td>7</td>
</tr>
<tr>
<td>0.9633</td>
<td>0.9979</td>
<td>0.2523</td>
<td>0.9643</td>
<td>0.9807</td>
<td>100</td>
<td>7</td>
</tr>
<tr>
<td>0.9626</td>
<td>0.9977</td>
<td>0.2463</td>
<td>0.9638</td>
<td>0.9804</td>
<td>250</td>
<td>7</td>
</tr>
<tr>
<td><strong>0.9645</strong></td>
<td><strong>0.9977</strong></td>
<td><strong>0.2543</strong></td>
<td><strong>0.9658</strong></td>
<td><strong>0.9814</strong></td>
<td><strong>500</strong></td>
<td><strong>7</strong></td>
</tr>
<tr>
<td>0.8653</td>
<td><strong>0.9969</strong></td>
<td>0.0849</td>
<td>0.8637</td>
<td>0.9235</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>0.8679</td>
<td>0.9964</td>
<td>0.0860</td>
<td>0.8669</td>
<td>0.9253</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td>0.8695</td>
<td>0.9964</td>
<td>0.0871</td>
<td>0.8684</td>
<td>0.9259</td>
<td>250</td>
<td>2</td>
</tr>
<tr>
<td>0.8703</td>
<td>0.9968</td>
<td>0.0880</td>
<td>0.8689</td>
<td>0.9264</td>
<td>500</td>
<td>2</td>
</tr>
<tr>
<td>0.9320</td>
<td>0.9968</td>
<td>0.1541</td>
<td>0.9329</td>
<td>0.9634</td>
<td>50</td>
<td>4</td>
</tr>
<tr>
<td>0.9298</td>
<td>0.9966</td>
<td>0.1488</td>
<td>0.9309</td>
<td>0.9622</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>0.9303</td>
<td>0.9968</td>
<td>0.1503</td>
<td>0.9312</td>
<td>0.9625</td>
<td>250</td>
<td>4</td>
</tr>
<tr>
<td>0.9297</td>
<td>0.9965</td>
<td>0.1482</td>
<td>0.9309</td>
<td>0.9622</td>
<td>500</td>
<td>4</td>
</tr>
<tr>
<td>0.9594</td>
<td>0.9968</td>
<td>0.2307</td>
<td>0.9613</td>
<td>0.9787</td>
<td>50</td>
<td>7</td>
</tr>
<tr>
<td><strong>0.9640</strong></td>
<td><strong>0.9967</strong></td>
<td><strong>0.2516</strong></td>
<td><strong>0.9662</strong></td>
<td><strong>0.9811</strong></td>
<td><strong>100</strong></td>
<td><strong>7</strong></td>
</tr>
<tr>
<td>0.9624</td>
<td>0.9968</td>
<td>0.2427</td>
<td>0.9643</td>
<td>0.9803</td>
<td>250</td>
<td>7</td>
</tr>
<tr>
<td>0.9625</td>
<td>0.9968</td>
<td>0.2435</td>
<td>0.9644</td>
<td>0.9803</td>
<td>500</td>
<td>7</td>
</tr>
</tbody>
</table>
Table 3. Performance of BR+ (Stat) using SMOTE-NC+T-Link

<table>
<thead>
<tr>
<th>Model</th>
<th>Accuracy</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Precision</th>
<th>F-Measure</th>
<th>N Tree</th>
<th>M Try</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y_1 \leq y_2$</td>
<td>0.8659</td>
<td>0.9974</td>
<td>0.0898</td>
<td>0.8641</td>
<td>0.9241</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>0.8742</td>
<td>0.9977</td>
<td>0.0960</td>
<td>0.8722</td>
<td>0.9287</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>0.8742</td>
<td>0.9975</td>
<td>0.0991</td>
<td>0.8723</td>
<td>0.9288</td>
<td>250</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>0.8707</td>
<td>0.9976</td>
<td>0.0939</td>
<td>0.8685</td>
<td>0.9263</td>
<td>500</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>0.9331</td>
<td>0.9973</td>
<td>0.1584</td>
<td>0.9335</td>
<td>0.9639</td>
<td>50</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>0.9330</td>
<td>0.9977</td>
<td>0.1609</td>
<td>0.9331</td>
<td>0.9639</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>0.9309</td>
<td>0.9973</td>
<td>0.1567</td>
<td>0.9313</td>
<td>0.9627</td>
<td>250</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>0.9302</td>
<td>0.9973</td>
<td>0.1548</td>
<td>0.9305</td>
<td>0.9623</td>
<td>500</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>0.9625</td>
<td>0.9979</td>
<td>0.2441</td>
<td>0.9634</td>
<td>0.9802</td>
<td>50</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>0.9628</td>
<td>0.9975</td>
<td>0.2460</td>
<td>0.9642</td>
<td>0.9805</td>
<td>100</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>0.9614</td>
<td>0.9978</td>
<td>0.2439</td>
<td>0.9624</td>
<td>0.9797</td>
<td>250</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>0.9624</td>
<td>0.9978</td>
<td>0.2499</td>
<td>0.9634</td>
<td>0.9802</td>
<td>500</td>
<td>7</td>
</tr>
<tr>
<td>$y_2 \leq y_1$</td>
<td>0.8660</td>
<td>0.9967</td>
<td>0.0866</td>
<td>0.8645</td>
<td>0.9237</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>0.8679</td>
<td>0.9963</td>
<td>0.0857</td>
<td>0.8668</td>
<td>0.9249</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>0.8732</td>
<td>0.9965</td>
<td>0.0893</td>
<td>0.8721</td>
<td>0.9282</td>
<td>250</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>0.8713</td>
<td>0.9967</td>
<td>0.0880</td>
<td>0.8701</td>
<td>0.9272</td>
<td>500</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>0.9295</td>
<td>0.9964</td>
<td>0.1478</td>
<td>0.9306</td>
<td>0.9620</td>
<td>50</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>0.9300</td>
<td>0.9966</td>
<td>0.1497</td>
<td>0.9311</td>
<td>0.9624</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>0.9305</td>
<td>0.9964</td>
<td>0.1488</td>
<td>0.9318</td>
<td>0.9626</td>
<td>250</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>0.9308</td>
<td>0.9969</td>
<td>0.1511</td>
<td>0.9316</td>
<td>0.9628</td>
<td>500</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>0.9622</td>
<td>0.9966</td>
<td>0.2417</td>
<td>0.9643</td>
<td>0.9802</td>
<td>50</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>0.9620</td>
<td>0.9966</td>
<td>0.2429</td>
<td>0.9641</td>
<td>0.9801</td>
<td>100</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>0.9627</td>
<td>0.9968</td>
<td>0.2461</td>
<td>0.9647</td>
<td>0.9804</td>
<td>250</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>0.9621</td>
<td>0.9968</td>
<td>0.2438</td>
<td>0.9640</td>
<td>0.9801</td>
<td>500</td>
<td>7</td>
</tr>
</tbody>
</table>

The optimum M try for both orders is 7, and the optimum number of trees for order $y_1 < y_2$ is 250 trees and for order $y_2 < y_1$ is 500 trees. Tomek Link also produces good models because the specificity is higher compared to SMOTE-NC. Because the model produces high accuracy, sensitivity, precision, F-Measure. Also, increase the specificity from 0 to more than 90%, but in some conditions, Tomek Link cannot capture data in the minority class or cannot correctly classify data in the minority class.

Table 3 shows the performance of random forest with BR+ (stat) using hybrid sampling consist of SMOTE-NC and Tomek Link. The SMOTE-NC is applied to the imbalanced data and after the data balanced, then Tomek Link is applied to the balanced data. The results from Table 3 show that the optimum model for both orders is when using M try 7 and 100 trees for order $y_1 < y_2$ and 250 trees for order $y_2 < y_1$. The classification using hybrid sampling also produces good model. Because the model can capture the data in the minority class.
The performance comparison of the three resampling methods is shown in the following Table.

Table 4. Performance Comparison

<table>
<thead>
<tr>
<th></th>
<th>Accuracy</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Precision</th>
<th>F-Measure</th>
<th>N tree</th>
<th>M try</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMOTE-NC</td>
<td>0.9645</td>
<td>0.9977</td>
<td>0.2543</td>
<td>0.9658</td>
<td>0.9814</td>
<td>500</td>
<td>7</td>
</tr>
<tr>
<td>T-Link</td>
<td>0.9879</td>
<td>0.9889</td>
<td>0.8501</td>
<td>0.9988</td>
<td>0.9938</td>
<td>250</td>
<td>7</td>
</tr>
<tr>
<td>SMOTE-NC+T-Link</td>
<td>0.9628</td>
<td>0.9975</td>
<td>0.2460</td>
<td>0.9642</td>
<td>0.9805</td>
<td>100</td>
<td>7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Accuracy</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Precision</th>
<th>F-Measure</th>
<th>N tree</th>
<th>M try</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMOTE-NC</td>
<td>0.9640</td>
<td>0.9967</td>
<td>0.2516</td>
<td>0.9662</td>
<td>0.9811</td>
<td>100</td>
<td>7</td>
</tr>
<tr>
<td>T-Link</td>
<td>0.9868</td>
<td>0.9877</td>
<td>0.9153</td>
<td>0.9988</td>
<td>0.9932</td>
<td>500</td>
<td>7</td>
</tr>
<tr>
<td>SMOTE-NC+T-Link</td>
<td>0.9627</td>
<td>0.9968</td>
<td>0.2461</td>
<td>0.9647</td>
<td>0.9804</td>
<td>250</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 4 shows the performance comparison of the optimum model from both orders and each resampling method. The model with SMOTE-NC and hybrid sampling to handle the imbalanced data produce high sensitivity compared to the model with Tomek Link, but Tomek Link has the highest accuracy, specificity, precision, and F-measure. The optimum model of Tomek Link can correctly classify the data in minority class as much as 100%, but in some conditions, Tomek Link cannot capture the data in the minority class. This is according to research by [12] where for extreme cases in imbalanced data (minority class less than 10%), Tomek Link shows the best performance as compared to hybrid sampling. Therefore, it can be concluded that the best method for order \( y_1 < y_2 \) is Tomek Link with 250 trees and M try is 7 and the best method for order \( y_2 < y_1 \) is also Tomek Link with M try is 7 and 500 trees.

4 Conclusion

According to the analysis that has been done before, it can be concluded that the optimum M try for the classification of multilabel data is 7 with a varying number of trees. Using the different order, the combination of BR+ (stat) and Tomek Link is the best method to overcome the multilabel imbalanced data as compared to the combination of BR+ (Stat) and SMOTE-NC and the combination of BR+ (stat) and hybrid sampling because the former has the highest accuracy, specificity, precision, and F-measure.

Acknowledgments. This research was funded by BKKBN. The authors thanks to BKKBN for funding which support this research and all individuals associated with this research work.

References


Internet of Things (IoT) on Fostering Meaningful Science Learning: A Literature Review

A Hujatulatif¹, J Ikhsan² and I N Khoiriza³
{adhahujatulatif.2020@student.uny.ac.id}

Science Education, Universitas Negeri Yogyakarta, Sleman Yogyakarta¹,³, Chemistry Education, Universitas Negeri Yogyakarta, Sleman Yogyakarta²

Abstract. Technological advances in this era are developing very rapidly, including 5G technology. This has led to the development of IoT which can be used in various fields including in education. Several researchers have developed IoT in education management or in learning. The purpose of this study is to provide an overview of the potential for IoT in science education as a preliminary study of our present research in use of IoT to improve the quality of meaningful science learning. This research is a literature review research. The review was carried out by analyzing articles in the Scopus, ERIC and Google scholar citation databases. In this case, IoT has been identified by several studies as having very useful potential to support more comprehensive learning activities. Based on the results of this literature review, IoT can be new breakthrough that has the potential to improve meaningful in science learning.

Keyword: Internet of Things (IoT), Meaningful Learning, Science Education, Science Learning

1 Introduction

Science is the systematic study of the structure and function of the natural world, including physical and biological characteristics. It is a field of philosophy concerned with the study of nature, processes, and interactions among diverse occurrences, with the ultimate objective of science being the discovery of the simplest general principles capable of explaining nature's vast complexity. These concepts may be utilized to learn more about the natural world and create predictions about what will happen in the future.

Theoretical thermodynamics may be used, for example, to forecast the rate at which temperature changes in a specific area. Science is a collection of interrelated ideas that emerge from experiments and observations and are valuable in future experiments and observations. It is known as the scientific method, which is a matured style of thinking. [1] Science is a technique of learning about natural events that has largely supplanted the impact of less objective approaches and worldviews [1]. Belief systems based on religion, morality, and aesthetics, for example, are important alternatives to science in all societies. These belief systems are largely aimed towards goals other than science, such as discovering purpose beyond simple existence, understanding how individuals are taught to act, and appreciating the worth of creative expression. Throughout history, numerous scientists have employed the scientific method to uncover new information and understanding [2].

AECon 2020, December 19-20, Purwokerto, Indonesia
Copyright © 2021 EAI
DOI 10.4108/eai.19-12-2020.2309180
The scientific method to learning involves five learning experiences in order to gain knowledge in science. Observation, questioning, acquiring knowledge, reasoning/associating, and communicating are all part of it. Its main objective is for pupils to understand the nature of studying science. Thus, children can discover their own concepts that are explored extensively, meaningfully, authentically, and actively in the process of studying science in school [1]. We are concentrating on encouraging one of the processes of scientific learning, namely meaningful learning, in this study. This indicates that the pupils will be able to comprehend and apply what they have learned in a meaningful way. This article explores an overview of how these meaningful concepts can be fostered to science learning.

The construction of meaningful learning was first popularized by Ausubel, who stated that meaningful learning is what happens when someone learns about new experiences and relates them to what that person already knows. Therefore, when someone experiences meaningful learning, it will imply a longer retention than memorizing. This occurs when humans connect new ideas or concepts with familiar, pre-existing concepts. Then with that comes the changes made in our cognitive structure, existing concepts are modified and perhaps new links are produced more comprehensively. This is something important to develop in learning because it allows learning to be contextual, results in greater retention and facilitates transfer to other real situations [3].

A researcher called Jonassen and colleagues used a constructivist viewpoint on the use of technology in schools to build technology-based activities that might enhance meaningful learning in the classroom in order to further improve meaningful learning. Then define meaningful learning as instances in which students actively participate in the creation of meaning, and they break this concept down into five qualities. Active (manipulative, observant), Constructive (articulative, reflective), Intentional (reflective, regulatory), Authentic (complex, contextualised), and Cooperative were the five characteristics (collaborative, conversational). They recommended that instructors begin to think of technologies as learning tools that students learn with rather than from, and that this approach reflects the manner in which technology is likely to be used by informal learners who are not restricted by externally imposed formal learning frameworks. As a result, the characteristics of meaningful learning proposed by Jonassen et al. were utilized to assess the learning that took place in their blog. A project is significant if it satisfies two requirements, according to Larmer and Mergendoller. First, students must consider the job as personally meaningful, an essential assignment, and one that they desire to do with the greatest amount of effort possible [4]. Second, programs that contribute to educational objectives [5].

Based on the above, to improve quality science learning, a meaningful science learning must be developed. Jonassen has revealed that this can be done with the help of technology. Today's technology continues to develop very rapidly, so the variety of technologies that can be used to help meet the criteria for fostering meaningful science learning is increasingly varied. One of the technologies today is the Internet of thing. The Internet of Things (IoT) is a network of physical and interconnected items that may be used to monitor and exploit information. The internet has evolved into a network of devices of all kinds and sizes, including automobiles, smart phones, home appliances, toys, cameras, medical equipment and industrial systems, animals, people, buildings, and wearables, where everything is linked. To accomplish intelligent rearrangement, positioning, tracking, security, and control, all tools and information may be exchanged and shared based on defined protocols, including personal real-time online monitoring, online augmentation, process management, and administration. The Internet of Things (IoT) is the latest Internet revolution.
Because they can transmit information about themselves in anything, IoT systems, individuals, or objects can make themselves automatically identifiable as information or information providers and develop intelligence by making or activating context-related judgments [6]. As a result, there is an idea to utilize IoT technology to encourage meaningful science learning since the potential IoT allows physical items to connect and interact as well as to equip them with intelligence to analyze particular information. This data may then be utilized to create decisions that are both socially and technologically valuable. It is very appropriate if IoT is used in science learning as a sample model of IoT can be seen at figure 1. It is based on previous developments regarding microcontrollers, directional mirrors, frames, and other hardware, a smart mirror, as a mirror display screen, offers a type that is safer, more convenient, faster, more precise, and smarter, and is information-based. As a result, it is hoped that this tool would assist students in becoming more creative, inventive, and enthusiastic about science[7][8][9].

![Figure 1. Sample model of IoT](image)

## 2 Method

### 2.1 Literature review : Internet of Things (IoT) on Fostering Meaningful Science Learning

This research began by looking for articles from three online search engine citation sources database, namely Scopus, Education Resources Information Center (ERIC) and Google Scholar, which are then displayed as follows:

<table>
<thead>
<tr>
<th>Keywords</th>
<th>Number of Article Found</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ERIC</td>
</tr>
<tr>
<td>Internet Of Things (IoT)</td>
<td>94</td>
</tr>
<tr>
<td>Meaningful Learning</td>
<td>5,430</td>
</tr>
<tr>
<td>Science education</td>
<td>5,1910</td>
</tr>
<tr>
<td>Science learning</td>
<td>3,0695</td>
</tr>
</tbody>
</table>

Based on this table, it is known that Google Scholar has a much higher number of search results than ERIC and Scopus. However, when viewed from the specifications and quality of the articles found, Eric has a high degree of accuracy because in ERIC it focuses on articles with
the theme of Education only. On searches, on the Scopus, Education Resources Information Center search engine and Google Scholar using the following keywords: Internet of Thing, meaningful learning, science education and science learning found around xxxx articles from Scopus, ERIC xxxx and xxx articles from Google Scholar. However, for internet of things (IoT) on fostering meaningful science has never been done, so it will be a very big opportunity for further researchers to continue research by this topic.

2.2 Literature review Internet of Thing

Today, the rapid progress in the world of technologies that have reached nearly every human being on the planet, 5G connections enable close and long-distance communication for everyone and everything. Now, anybody, everywhere, and at any time may access information and communicate using this technology. The Internet of Things is one of these technologies (IoT). The Internet of Things (IoT) is a future version of the Internet that will allow machine-to-machine (M2M) learning.

For both software and hardware applications, the long-term goal of the IoT curtain is to provide independent communication, secure power, and enable the flow of genuine information for everyone on the planet. The Internet of Things (IoT) establishes links between real-world physical causes and the virtual world [10]. The assistance of numerous helper apps, the means of Internet contact have advanced very fast, linking zillions of other things, both good and bad information, all over the world, and some of these objects from varied processing capacities, sizes, calculations, and pressures. These networked items contain data that can be gathered, evaluated, and utilized to start activities through particular instructions, giving a great deal of intelligence for planning, management, and accurate decision-making based on sophisticated, real-time analytical processes. This figure 2 explain the general of IoT as follow:

![Fig 2. Internet of thing in general](image)

3 Result and Discussion

3.1 Internet of Thing in Science Education

IoT has been recognized as a new technology that will have a significant impact on a variety of areas, including business, health care, transportation, education, and even scientific future
Internet connectivity is rapidly expanding and is already widely utilized in our daily lives; there are presently 5 billion "smart" linked things in use, with that number expected to rise to 50 billion by 2020.

The Internet of Things (IoT) will continue to expand as internet access speeds improve. Even during the Covid-19 epidemic, inventions such as the 5G connection have a significant impact, since everyone is obliged to connect to the internet because of a lack of physical distance. This has also caused individuals to become increasingly connected to the internet, causing all internet providers across the world to boost their internet speed capabilities in order to accommodate the massive amounts of data flowing through the internet network.

The Internet of Things (IoT) paradigm may be defined as the numerous items that surround us and are connected to the internet in some way. To put it another way, instruments in the environment like as televisions, lights, vehicles, telephones, and even plants may be connected with smart sensors and communicate and interact with one another via wireless networks or the internet at any time and place to create specific information. The Internet of Things is born from the integration of mobile devices and sensors in smart objects, ushering in a new age in education.

Furthermore, there is a reference saying that researchers performed study in the science inquiry system of primary school pupils in Hong Kong by constructing mobile or cellular devices. Researchers found that mobile technology aids pupils' scientific research and helps them build critical thinking abilities. Students are permitted to utilize tablet computers and commercial science inquiry programs on the shelf in the learning they generate, according to reports. The findings suggest that combining mobile learning with inquiry-based learning environments may be done successfully [13].

Recent study in the United Kingdom has demonstrated how the Internet of Things may improve the quality of science and other subjects such as technology and geography. This project assists students and instructors in measuring, sharing data, and gaining a better knowledge of their surroundings in a fun yet educational way, with the ultimate objective of developing the next generation of lesson plans. Following implementation, the project discovered that the IoT could provide new learning experiences by allowing students and teachers to delve deeper into the data they generated, stimulating open-ended classroom discussion and discovery, and shifting time in the classroom from setup to higher-level learning activities.

However, the researchers discovered that when students gathered data from weather sensors, they were less interested and driven. So, if there are people who want to pursue this research in the future, they must focus on how to address the students' lack of desire. Even yet, some of the items they discovered may still be utilized as references to help students understand science [12]. Smart objects will be utilized at universities in 2017, according to a previous reference, and this has now happened and will soon be widely used in K-12. In the future, educators and technology developers will have a huge problem in finding new ways of learning and ensuring that new learning methodologies based on their utilization are acceptable for students in the twenty-first century. Something that has a lot of promise for academics to work on next, because it will obviously have a big influence on the quality of learning.

3.2 Internet of Thing on Fostering Meaningful Science Learning

After looking at the various references that have been reviewed above, as we have previously stated that we have the idea of using IoT technology to foster meaningful learning in science learning because of the potential for IoT that we have discussed previously which allows
objects in this case are media learning, students, teachers or facilitators and tangible science learning objects can connect and communicate and equip them with intelligence to process specific information. Next, we will develop a special IOT system in science learning. A subject for learning about living and non-living things by watching real-time sensory data and videos or photos of growing peanuts (living things) and rocks (non-living things) using the IOT system we created.

Table 2. Adapted Rubric for Identifying the Attributes of Meaningful Learning

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intentional</td>
<td>1. Students choose their own learning objectives.</td>
</tr>
<tr>
<td>Learning</td>
<td>2. Students create knowledge using different methods such as timelines, graphs, mind maps, and idea maps.</td>
</tr>
<tr>
<td>Constructive</td>
<td>1. Students are often thinking about what they're studying.</td>
</tr>
<tr>
<td>Learning</td>
<td>2. Students may critically and constructively examine, evaluate, and criticize the ideas of their classmates.</td>
</tr>
<tr>
<td></td>
<td>3. Students are allowed to reply to questions posed by the instructor.</td>
</tr>
</tbody>
</table>

The IOT device produced for this project will be the instrument utilized in the following investigation. The information was gathered via the students’ reflection reports and messages on their learning experiences, which were stored on the gadget. The qualitative data will be analyzed using a rubric modified by Mohamed Amin and Amelia from Jonassen's rubric, which is based on four significant learning characteristics (see Table 2). In this study, the modified version of the rubric was used since the five qualities of meaningful learning matched the study's requirements.

4 Conclusion

This study offers a literature review research project based on the Internet of Things (IoT) paradigm in scientific learning, which has the potential to provide significant benefits to students. The growing popularity of the Internet of Things has permitted the creation of an innovative, relevant educational learning tool for students studying science. It is envisaged that IOT-based learning would enable students to experience customized, rich, and interactive learning whenever and wherever they require it. As a result, collaborative involvement outside of the classroom can make the learning process more dynamic.

We are now evaluating our IOT ideas' system before conducting a deployment study of the prototype in Indonesian schools. The research will look into how students engage with the IOT system and how effectively it promotes scientific experiment learning. The purpose of the observation will be to learn how kids interact with their peers, teachers, and the tools used to perform IOT systems. Students will learn about living and non-living things by using the IOT system to see real-time sensory data, videos, or photos of growing beans (living things) and rocks (non-living things). To measure students' involvement in learning and the usability of the IOT system, questionnaires and interview sessions will be used. The gadgets of the Internet of Things will also be evaluated for dependability, robustness, and user-friendliness. When the
data collection is complete, the users' attitudes, views, engagement, and learning efficacy in relation to IOT for encouraging meaningful learning in scientific learning will be examined. This product will then be used to produce a final generic design framework, guidelines, and applications.

References

[6] Vermesan, Ovidiu;Friess P 2012 Internet of things vol 25, ed MARINA RUGGIERI (Denmark: River Publisher)
[10] Xi W and Patton E W
Analysis of Learning Difficulties Learning Cultural Arts as a Form of Creativity for Elementary School Students

Lia Mareza
{liamareza@ump.ac.id}
Universitas Muhammadiyah Purwokerto, Purwokerto, Indonesia

Abstract. Practical learning Cultural arts as a form of creativity is learning that brings students to learn arts and culture creatively. Creativity learning can encourage students to learn effectively and get maximum results, both in class and in competition achievements. This study aimed to determine the analysis of learning difficulties in teaching arts and culture as a form of creativity for students with special needs in elementary schools. The research used descriptive research with a qualitative approach. The research subjects were students and teachers of SD Negeri 1 Tanjung Purwokerto. Samples were taken using saturated sampling, namely, using all members of the population as a sample. The data analysis method used is descriptive qualitative. The results showed that learning cultural arts was learning at SD Negeri 1 Tanjung Purwokerto in many methods, because of the form of creativity need cooperation between teachers and students in the implementation of learning, such as lots of students did not understand the material, doesn’t send an assignments according to the teacher's time, and didn’t paying attention to the teacher when explaining the material. Learning plans are made based on competency standards and necessary competencies. Teachers should have used various methods combined with theory and practice according to the material so that cultural arts learning in class runs optimally. Creativity learning difficulties can be seen in the achievement of students in each assignment made. Still, only a few students are motivated to participate in competitive activities because it is influenced by inhibiting factors from students, teachers, support from parents, and infrastructure.

Keywords: Difficulties Learning, Creativity, Elementary School

1 Introduction

Education is a determining factor in the success of human resource development. Education is used to develop individuals, especially students, to achieve the necessities of life. Besides, education is used to introduce students when they go to the community to be ready to face existing problems and know how to solve them. In this era, the curriculum must equip students with various competencies, which are used to meet the challenges that exist. The competencies needed in this era must be following global developments, such as communication skills, critical thinking skills, creative thinking skills, intelligence according to talents and interests, have a sense of responsibility towards the environment, and have a broad interest in life. Following the contents of educational objectives, including the development of each individual’s potential,
such as attitudes, knowledge, and skills, children are equipped with knowledge about theory and skills. Creativity is very much needed in terms of education, society, and culture.

Creativity reflects divergent ways of thinking, namely, the ability to provide various alternative answers. The invention can be used to predict learning success [1]. Learning activities should be a bridge to producing creative works because it is a continuous process in education to form vital and creative resources. [2], Many groups made various efforts to stimulate children's creativity from an early age, starting from before birth (prenatal), infancy to children's schooling. For example, music, art, various types of games, and books stimulate children's creativity. Children are already fluent in finding and expecting information from their surroundings. According to [3], elementary school children aged 7-12 years of development are thinking at the concrete operational stage. Children at this stage need physical experiences such as manipulating tangible objects to form their logical thinking experiences. At this stage, the child can think logically but still needs concrete things according to their imagination and desires to understand abstract concepts. For this reason, creativity needs to be nurtured and developed from an early age, especially at the elementary school age, because at these ages, there is a "critical period" in addition to the "peak period" for the development of creativity.

Each individual has different potentials and talents; for example, singing skills can be developed by learning the art of music, dancing can be acquired through learning dance, and painting skills developed in fine arts learning. These skills are integrated into the subject of Cultural Arts and Crafts (SBdP). Cultural arts and crafts education is given to elementary school students to foster students' love for Indonesia's cultural arts. Cultural arts learning also plays a role in shaping the personality of students by paying attention to individual development in achieving the right brain balance, which includes intrapersonal intelligence, visual spatial, musical, linguistic, mathematical logic, naturalist and adversity intelligence, creativity, spiritual and moral, as well as emotional intelligence. Creativity learning is also an entertainment subject for students because students can be creative and express themselves according to what they want as outlined in work.

[4] also stated that school-age is the effective years in human life to develop creativity. Children's potential at that age is significant for their development to be stimulated to ensure that psychological freedom is maintained. [5] stated that the environment expected to be able to realize children's creativity is family and school. Schools that are expected to provide an educational atmosphere to develop children's creative talents are trapped in optimizing only one aspect, namely training in knowledge, thinking logically / reasoning, and memorizing, so that creativity during school children is the less developed world of education. Cultural Arts and Skills as one of the fields of study in learning by looking at the background will foster competitive moral intelligence. This background is as follows: the content of arts and culture and skills as mandated in the Government of the Republic of Indonesia Regulation Number 19 years 2005 concerning National Education Standards is not only in one subject because culture itself covers all aspects of life. In Cultural Arts and Skills, cultural elements are not discussed separately but are integrated with art. Therefore, the subject of Cultural Arts and Skills is a culture-based arts education.

Fine arts activities are activities in the art area that are non-academic, fun, and flexible. Through art activities, children with special needs become active because children explore various media. The media here is a material or means of creating a work of art. Fine art activities will not make children feel bored and lazy. In this activity, children will be busy making new things and using their imagination to create something unique. [6]. Cultural arts and skills education is given in schools because of the uniqueness, meaning, and benefits of students' development needs. Which lies in providing aesthetic experiences in the form of
expressive/creative activities through the approaches: "learning with art," "learning through art," and "learning about art." Other subjects cannot give this role. Arts and Culture and Skills Education have a multidimensional and multi-development ability to express oneself creatively in various ways and media such as visual language, sound, motion, roles, and multiple combinations. Multidimensional means developing multiple competencies, including conception (knowledge, understanding, analysis, evaluation), appreciation, and creation by harmonizing the elements of aesthetics, logic, kinesthetic, and ethics. The multicultural nature implies that art education fosters awareness and appreciates various cultures of the Archipelago and Abroad. Cultural Arts and Skills Education have a role in the personal formation of students who are harmonious with attention to the development needs of children in achieving multicultural intelligence, which consists of intrapersonal, interpersonal, visual-spatial, musical, linguistic, mathematical logic, naturalist, and adversity intelligence, creative intelligence, spiritual intelligence and moral, and emotional intelligence [2].

Learning art can encourage students to express their understanding of the subject matter through art forms. Art can train students' imaginative abilities and develop potentials that produce works and increase students' creativity. Being creative does not only apply to artists, but creativity is essential for all fields of knowledge. Art education's position and function are equalized with other subjects in teaching to foster students' sensitivity. Provide the opportunity to develop the competencies and personal potential of students. Besides, art education can increase potential regional capabilities by producing works of art. Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 79 of 2014 concerning Local Content of the 2013 Curriculum states that: Cultural arts education covers various aspects of life. The essential competencies of local content relating to arts, culture, and skills are integrated into cultural arts and crafts subjects. Cultural arts education positions students as heirs to the nation's creative and intellectual intelligence. In skills, outstanding arts, children can develop their interest in working in works in objects.

The National Education Association (NEA), which is an association of professional educators, sets the goals of fine arts education, namely that children can develop an appreciation for beauty, increase their creativity, develop a vision, and develop the ability to voice aspirations [7]. Also, art education equips students in making or creating works with the skills they learn. Educators can develop students' talents in working on Cultural Arts and Crafts; this subject includes learning music, dance, and fine arts. Fine arts learning emphasizes the needs and habits of students in their daily work. In practice, educators can adjust learning to the goals of art education in their schools. Elementary school-age children have different aesthetic characteristics from adults based on their distinctive features. Appreciatively, elementary school-age children have been able to capture the vibrations of a sense of beauty that comes from outside, even though it is very subjective and depends on their respective tastes. This means that students can understand, observe, and feel beautiful things around them. Elementary school-age children have characteristics in doing artworks. Students work on what they want to create according to their feelings, such as sadness, happiness, fantasies, and daily stories. What students often see, how emotions and results of imagination become a strong influence in creating works. Educators are expected to guide students to develop ideas and ideas that students have and put them into position and make students' level of creativity in facing the obstacles they experience when the learning takes place.

The development and implementation of a competency-based curriculum are among the national education development strategies in Law Number 20 of 2003 concerning the National Education System. In this regard, educational institutions have an essential role in developing the creativity of their students. Currently, some educators have convergent thoughts without
providing opportunities for students to create ideas that students have. Educators will be able to develop creativity in their students if educators also get used to thinking creatively. Conversely, if educators are accustomed to convergent thinking, creative thinking development will be challenging to achieve.

Researchers have conducted interviews with class teachers at SDN 1 Tanjung Purwokerto. From the interviews conducted by researchers with the principal of SDN 1 Tanjung Purwokerto, it can be explained that SDN 1 Tanjung Purwokerto has used the 2013 curriculum as its learning curriculum. In this curriculum, there are subjects of Cultural Arts and Crafts where implementing learning, especially in art, is carried out based on educators' abilities and the availability of existing infrastructure. The competence of educators who do not have a background in the arts makes educators teach art learning according to their abilities. In practice, if the material is deemed challenging to teach students, educators only teach material according to their abilities. The limited-time in SBdP subjects for 2 hours of lessons (70 minutes) is considered less efficient in teaching the material. Learning SBdP, which is placed at the beginning or in the middle of learning, makes the class atmosphere not conducive. Although cultural arts learning has many obstacles, SDN 1 Tanjung Purwokerto is quite accomplished. Learning difficulties are conditions of children with average intelligence abilities. Still, they have learning disabilities or failures related to obstacles in the process of perception, conceptualization, language, memory, and concentration of attention, self-control, and sensory integration functions—5 motor [8]. Students still have difficulty expressing or visualizing works of art in learning cultural arts and skills. Students also tend to imitate existing work without any guidance in terms of object selection and color use. The teacher has not been guided to provide a stimulus for students to draw according to their imagination and inspiration; apart from this, the teacher does have obstacles in giving instructions and directing the making of artwork following the object he chooses. The teacher's nature only follows and adjusts the work in the book, then accepts and evaluates it without any form of evaluation or appreciation from the teacher of the student's work.

From the obstacles in implementing fine learning arts in class, it is hoped that educators will provide solutions or follow-up following class conditions. The condition of the type that is meant is that educators must adjust the material with students' characteristics; besides that, educators must be able to provide innovations in existing learning to feel interested and active during the learning process. Educators need to increase the creativity of students. Therefore educators must also think creatively in developing existing education. The research will focus on the implementation of cultural arts learning in developing the creativity of students. Based on existing data, researchers ask how cultural art learning performance at SDN 1 Tanjung Purwokerto. Of course, in the learning process, there are so many things that can be analyzed from this situation, from the existence of the factors that hinder the implementation of learning above, how the follow-up is given by the educator in overcoming existing problems. Every educator can develop learning according to the creativity level of students. Based on the background, the researchers are interested in studying the simple cultural performances implemented in Crafts. This study only limits how the implementation of cultural arts learning, especially Fine Arts, in developing creativity student the educator gives the follow above, and the researcher is interested in researching the can difficulties in learning cultural arts as a form of student with special needs creativity at SDN 1 Tanjung Purwokerto, which is very important to do. For this reason, the researcher feels it is essential to analyze learning difficulties in learning cultural arts as a form of student creativity at SDN 1 Tanjung Purwokerto.
2 Method

The research method used in this research is descriptive qualitative because it aims to describe learning difficulties and creativity and the local content of cultural arts learning in teacher and student and local cultural values related to the learning content. The local culture in this research is Indonesian cultural values. Research subjects are parties who are used as samples in a study. The subject's role is to provide feedback and information regarding the researcher's data and provide input to the researcher, either directly or indirectly. Researchers chose research subjects in the form of objects, namely teachers and students, and informants, including children with special needs, 3 class teachers, one cultural arts and crafts teachers, and three students' parents. This study's variables were learning difficulties, creativity, aspects of the cultural arts learning content, and local culture in elementary school children's lives. Data collection was collected utilizing document recording and interviews. The documents used include teacher's documents, student books. The interview method was conducted by extracting information from sources (cultural observers, classroom teachers, cultural arts teachers, and parents of elementary school students) about local cultural values.

3 Results and Discussion

Indonesia is famous not only for its rich natural resources but also for its rich arts and culture. Six of them have been designated as Indonesian Cultural Heritage recognized by UNESCO, namely Wayang, Batik, Angklung, Saman Dance, Keris, and Papuan Noken. Art is a beauty that humans can enjoy, namely, in the form of activity to convey feelings through work. The function of art itself is as an expression of the human self, apart from that as education. Art in education is to be used as a medium for the education itself because the essence of art is actually related to educational content and is usually directly related to the traditions in each region in Indonesia. Many studies have explored and analyzed cultural arts and the process of creativity for education. [9] with the study results indicate that educators have difficulty formulating goals because the material to be developed is centered on the cognitive and psychomotor domains. Teachers find it difficult to create fabric in a useful direction. The teacher plays an essential role in determining the success of the learning implementation process. Of course, this is an enormous task for education to deepen students' creativity, especially students with special needs. For students with special needs, creativity is significant in their lives so that in the future, they can face the problems of their lives. With high creativity, students with special needs will not experience difficulties and will always be ready to overcome life's obstacles. For example, creative students in doing lesson assignments will always try to make their artwork assignments. With this creativity, strong personalities will emerge in reliable self-identities, self-consistency, and exemplary personal qualities.

Learning models can also help teachers in implementing cultural arts learning and are very much needed in everyday life as a way to achieve learning goals in the absence of a teacher in the field of arts and cultural studies and assigning teaching assignments in this field of study to teachers whose expertise is not in the areas of arts and culture. Meanwhile, teachers' scope of arts and cultural studies cannot be taught in other study areas. These non-art and cultural education teachers are given the task of teaching arts and culture subjects but are not maximal in their application in doing artwork. Teachers often convey only the theory that is in the student
textbook. Only the cognitive aspects and learning are described in the classroom to feel bored and bored, less interested in Cultural Arts and Crafts. Even though children are expected to perform specific tasks at every developmental period according to their development level, teachers can adjust by adjusting by planning learning models and methods related to art and culture learning materials. [10] The learning model's purpose is a plan or a pattern used as a guide in planning classroom learning or learning in tutorials and determining learning tools, including books, films, computers, curriculum, and others. The learning model directs teachers in designing learning to help students with special needs to achieve learning objectives. Learning achievement designed in a model can determine its success. Thus the model must have its character and characteristics. [11] argue that the learning model has a broader meaning than strategy, method, or procedure. The teaching model has four unique features that are not owned by process, practices, or systems, for example, as follows:

1. Logical theoretical rationale compiled by the creators or developers.
2. The foundation of thinking about what and how students learn (learning objectives to be achieved)
3. Teaching behavior necessary for the model to be implemented successfully and
4. The learning environment required to achieve the learning objectives. [10].

In educational learning, art bases the production or creation of art on creativity, and to motivate art creation, students and teachers should also be creative. Teacher creativity can be seen in how the teacher prepares the lesson material to not dull. Here the teacher needs to intersperse with a play model or add various media and displays created spontaneously or planned to grow new ideas in creating art. Creativity is a manifestation of a fully functioning individual in the form of himself. This means that students with special needs can develop and use all their talents and abilities and enrich their lives. Creativity allows humans to improve their quality of life. The function of learning cultural arts and crafts is also expected to participate in developing cultural arts and skills in the era of globalization. Art education fosters developing feelings through the production or behavior of art and training in artistic, emotional sensitivity, which contains knowledge about beauty. Teachers' learning approach, so far, has changed the teacher center to a student center-oriented method. Students are the center of attention in learning, while teachers change their function to become facilitators, mediators, motivators. The learning approach's implication with this change of learning paradigm is that teachers and students learn from each other and work together. Therefore, teachers must be open and willing to learn from students, especially students with special needs who have advantages in specific knowledge fields.

Cultural arts teachers must have; (1) a sense of visual art, namely responsiveness/sensitivity to visible symptoms / aesthetic forms, (2) understanding of auditory art, namely responsiveness to the emergence of various audio symptoms, including sound / sound dynamics. And (3) a sense of kinesthetic readiness to respond to the emergence of multiple types of material motion. If the three things above are owned, the art and culture teacher will provide enormous opportunities to develop and find creative ideas for learning arts and culture that are more meaningful and of higher quality. When there are students who have difficulty doing the teacher's assignments, the teacher is very dexterous to help direct, good cooperation between the two teachers in the class makes the classroom atmosphere more effective so that students can understand all the material being taught, and students also become more happy and active in learning, the ability of teachers to use learning media and good mastery of material makes it easier for teachers and students to carry out learning especially arts and culture which practice more. [12]
The education system needs to be adapted to developing each student's characteristics with special needs in all fields that require different types of expertise and skills and can simultaneously increase creativity. In the learning of Cultural Arts and Crafts, problems are often found about the material or materials needed by teachers and students to be used as material for making works of art as a practice, for example, the theme of activities for making pottery as daily tools, necessary competencies showing appreciative behavior towards Nusantara crafts, student indicators can make crafts. According to the student textbook, the materials used are difficult to find in the student environment. Teachers or students have to buy it somewhere far from their neighborhood. Besides, it is sometimes expensive. So that students with special needs who come from fewer economies cannot afford it. Similarly, it takes time to get it. Therefore, students often do not bring what materials they were ordered to practice learning Cultural Arts and Crafts. This is usually a real condition in schools; besides that, student creativity becomes low, so that the students' artwork is not maximal in this lesson. Based on this, it can be concluded that there must be a solution used as an alternative media for art product material, easy to find in the student environment, inexpensive and safe for children.

Students with special needs have difficulty learning in learning art as a form of creativity. If it is seen from doing their assignments, it is known that students do not all do their tasks, some students make their assignments, and relatives assist some, and those who do groups by friends. Then, suppose it is seen from students' understanding of cultural arts material. In that case, it is known that students understand when the teacher delivers the material, and some students have not expressed their form of creation when the teacher provides material on cultural arts. This is evident that almost all students who are taught cannot explore the artistic skills being taught. This happens because it is caused by several factors, including insufficient learning of concepts, the lack of time allocation provided, the methods used are less varied and not innovative so that it is boring and does not attract students' interest, incomplete learning facilities, and lack of willingness to explore or want to study the material being taught. Knowing difficulties experienced by students with special needs are caused by various factors, which state that the causes of learning difficulties can be grouped into two, namely internal factors and external factors. Internal factors are divided into two kinds of factors, namely physiological factors and psychological factors. Physiological factors related to students' characteristics include aspects of health conditions and the five senses' shape. In contrast, psychological factors include aspects of skills, interest, and motivation. External factors are divided into two kinds of factors, namely social factors and non-social factors. Social factors include family, school, and community, while non-social factors include humidity, study time, weather, school buildings, and learning tools.

Factors that come from within students (internal factors) include motoric abilities, affection such as feelings and self-confidence, motivation, gender, memory abilities, and ability to feel or appreciate. While factors that come from outside students (external factors) include factors related to the learning process, which provides for teachers, learning quality, time and the environment, both social and natural environments. The problem of learning difficulties by [13] is also grouped into two causal factors, namely internal and external factors. Internal factor problems include student characteristics, attitudes towards learning, learning concentration, the ability to process learning materials, the ability to explore learning outcomes, self-confidence, and study habits. At the same time, external factors include teacher factors, social environment, school curriculum, and infrastructure. Characteristics of learning difficulties in art and culture learning materials for children with special needs, namely:

a) Disorders of spatial relations
The concepts of spatial relationships such as front and back, top-bottom, top-bottom, high-low, beginning-end, and far-close are generally mastered by children when they have not entered elementary school. Children have understood the various concepts of these spatial relationships from their experiences communicating with the social environment. Children with learning difficulties often have difficulty communicating. The social environment also usually does not support implementing a situation conducive to communication between children with special needs. Extrinsic conditions in some social settings that do not support the implementation of communication and intrinsic requirements that are thought to be due to brain dysfunction can cause children to experience problems understanding the concepts of spatial relationships, which can interfere with children's understanding of objects and images.

b) Abnormalities in visual perception, children with learning difficulties often have difficulty seeing various items concerning groups or sets. Such a problem is a symptom of abnormal visual perception.

c) Visual-Motor Association, children with learning difficulties cannot count objects in sequence. This kind of child can give the impression that the child has only memorized things without understanding their meaning.

d) Perseveration, there are children whose attention is attached to an object only for a relatively long time. Such attention disorders are called perseveration. Such a child may initially be able to do a task well, but his attention is attached to a particular object over time.

e) Difficulty recognizing and understanding symbols. Children with learning difficulties have difficulty acknowledging and using motifs or ornament symbols. This kind of problem can be caused by memory disturbances but can also be caused by visual perception disorders.

f) Disorders of the body's appreciation, the child has difficulty showing a body image disorder. The child finds it difficult to understand the relationship between the parts of the body on their own. If the child is asked to draw the whole picture, they will pull the body parts in the wrong position.

g) Difficulty in symbolic language and reading. Therefore, language difficulties can affect reading ability to solve them. Therefore, children who have difficulty reading will also experience difficulty in expressing written stories.

h) Performance This intelligence test has two subtests, a verbal test and a performance test. Performance tests include (1) completing images, (2) compiling images, (3) arranging blocks, (4) placing objects, (5) coding.

The results of the author's observations at the beginning found that the arts and culture subjects were only for children who were interested and talented; the arts and cultural issues were held to accommodate the artistic talents of students who were not many. The position of cultural arts subjects is difficult to place as a primary material for intellectual empowerment and the potential for students' creativity. Besides, the fundamental problem in implementing cultural arts learning is the professionalism of cultural arts teachers. Cultural arts teachers must be smart in facing the various issues that occur in learning crafts and culture. To answer these problems is to take advantage of the many available learning facilities and resources. Of course, this is not easy to implement in the form of concrete actions by cultural arts teachers without equipping themselves with an understanding of universal cultural arts insights. Therefore, learning artistic skills must be understood as the fundamental science values that are technical-practical, theoretical, and constructive. Learning art as a skill lesson is considered no longer following
education with the principles of flexibility, responsiveness, being active, and creativity. Therefore, teachers of cultural arts now have to start reinterpreting and redefining their learning paradigm again. [14]

Students are more excited about the demonstration learning model. The obstacle found in learning cultural arts is when they will do works that require them to imagine themselves. Props are also often an obstacle to work. One simple way this is done is to reduce the lecture method by applying the demonstration method, which is interspersed with the provision of theories relating to the material being taught or currently in progress. The demonstration method that is significantly used supports the increase in student motivation in learning cultural arts because students are more provoked in doing work or imitating and understanding what is shown. Introductory material is given at the beginning of the practice and then conducts the training, interspersed with questions and answers during breaks. The media helps students make a form of work that, initially, students are not interested in using soft materials to become interested. Besides this material is easy to find, the demonstration method is also a way to attract students' interest in creating fine arts.

The availability of competent teaching staff also greatly helps used significantly applied motivation in learning cultural arts. Also, the availability of an art space, teaching media, and a supportive family environment is a knowing that the learning process of cultural arts in schools can be carried out correctly and has changed est of students who previously still had less interest and motivation to become more motivated to learn artistic skills. Besides that, students also know the benefits obtained in learning cultural arts. Obstacles that were found, such as a lack of time allocation in cultural arts lessons, can also be overcome using time in the afternoon to continue the material. The method used is also beneficial for students to learn more about the material being taught. Efforts are made student motivation in learning cultural arts, for example, through various learning models.

4 Conclusions

Children have understood the various concepts of these spatial relationships from their experiences communicating with the social environment. Children with learning difficulties often have difficulty communicating. The social environment also usually does not support implementing a situation conducive to communication between children with special needs. Besides, the fundamental problem in implementing cultural arts learning is the professionalism of cultural arts teachers. Cultural arts teachers must be smart in facing the various issues that occur in learning crafts and culture. To answer these problems is to take advantage of the many available learning facilities and resources.

References


The Application of Padlet in Teaching and Learning of Writing Recount Text at Senior High School in Palu City

E Mulyadi1, A Naniwarsih2, F A Omolu3, I Manangkari4, and D Rara Amiati5
{ernitasarim@yahoo.com1, andi.naniwarsih18@gmail.com2, fikalu@yahoo.com3}

Faculty of Teacher Training and Education, English Department, Universitas Muhammadiyah Palu, Centra Sulawesi 94118, Indonesia

Abstract. Writing skill is one of the essential skill in English language skills that should be mastered by Senior High school students. Meanwhile, writing is perceived as one of the most challenging and less attractive skills to be learned. The application of Padlet as a learning media is an alternative strategy for motivating and promoting students to write. Therefore, this study attempted to provide transparent information of the integration technology in teaching and learning English writing skills, particularly in writing recount text using Padlet, and how the student's response and attitude toward the use of Padlet in the writing process. This research applied a case study and conducted at Grade Eleventh, Madani Senior High School. The data were collected through observation, interviews obtained from the teacher, and questionnaires for the students. The researcher employed a Qualitative approach in analyzing the data. The findings show that students accepted the application of Padlet in conducting the teaching and learning process, it gives a positive effect on the students learning performance: 1. it was about 85% student can do the task collaboratively and cooperatively, 2. students were motivating and participating actively in-class activities. These findings suggest that the use of Padlet can be implemented at other schools in Palu City.

Keywords: Padlet, teaching and learning, writing skill, recount text.

1 Introduction

Writing skill is a Productive skill. According to [1], writing is a productive skill, and it is a creative act in expressing ideas, writing also can help the students to explore their thoughts and feeling. That means that productive skill refers to the skills that enable the learner can produce the language in written forms using words or sentences. They can communicate with others or express their idea or thought through written text, other than orally.

Writing skill is one of the English language skills that should be mastered by High School students. [2] outlined that the English learning scope for the eleventh-grade students is to be interpersonal discourse, transactional and functional, logic and coherent rhetoric, communication, and potential academic development in five practical speech such as; recount, narrative, procedure, descriptive, and report. One of the writing text Genre and Language function should be taught Recount text. [3] stated that recount text is to list and describe past experiences by retelling events in which they happened (chronological order). This recount text aims to provide the audience with information about what and when it occurred. In
response to the above statement, the student would construct their idea or write things based on their experience.

However, as in reality, writing is considered one of the most challenging skills for second and foreign language learners to master. The students seem reluctant to focus on writing activities, and they have less enthusiasm and confidence in writing. Several reasons for the reluctance; most students rarely write even in their language. Writing activities is not a habit for them, and most students are unfamiliar with conveying their idea and thought or telling their personal experience in writing. Moreover, the students could not write both free writing and writing systematically in the previous grade. Other reasons are they have no idea to say and do not know what to say.

Motivation is one of the critical success of a student in writing, and it is required to stimulate students' eagerness in writing. A strong effort from the students itself is needed to arouse their writing motivation. Students’ inner motivation will influence the learning process they experience in. The higher intrinsic motivation they have the more encouraged they will be. Moreover, the higher innate (intrinsic) learning motivation the students possess, the more possible they achieve competence and skills from the intake process. However, other factors such as the teaching method and the availability of teaching and learning facilities will also build students’ confidence in writing.

The numerous available facilities such as IT in writing and high intrinsic motivation from the students would interest them in the writing process. In line with [4] emphasized that technology makes learners’ learning exciting and interactive and increased their motivation, social interactions, and engagement. It can be inferred that the proper use of technology can determine the students’ cause to write. Technology has a particular role in motivating students, and it can be called intake learning process motivation because the motivation is gained from the previous learning experience.

The rapid development of technology provides positive educational changes, particularly in language teaching and learning. The use of technology can facilitate the students and teacher in the teaching and learning process. Students have ample opportunities to acquire more knowledge. They can even create an enjoyable learning environment themselves, such as the use of Multimedia Technology, featuring audio, visual, animation effects, and social media in the learning process. The internet provides easy, immediate, and virtually unlimited access to software and applications which can facilitate and speed up the English teaching and learning process.

One of the innovations of the teaching and learning of writing skills is applying the technology (Padlet) or known before as wall-wisher. This study investigates the application of Padlet in the teaching and learning process of writing recount text, students’ learning performance, and giving an overview of how the student's response and attitude toward the use of Padlet in the writing process. Padlet is one of the online media can be used as an alternative way of teaching writing skill. According to [5], Padlet gives a free application, a multimedia-friendly wall used to encourage real-time, and promotes full class participation and assessment. Applying Padlet in the teaching and learning process has some advantages. The use of Padlet fosters students’ creativity, students can modify the information using the text, but they can also easily use the multimedia element to enrich their knowledge. Students can upload videos, images, documents, and PDFs, share links, or provide comments on each other's posts, or they can create public or private walls.

Padlet also promotes collaborative and cooperative learning. This idea is supported by [6] several platforms that can encourage students to collaborate in the writing process either in the classroom or in virtual learning, such as blogs, Facebook, wikis, and Padlet. Using Padlet in
the writing learning process makes it easier for students to work collaboratively. They can post their paragraph writing or essay on the wall, and other students would give the comments either as suggestions or corrections. They can enrich their knowledge and learn from each other. Furthermore, conducting the writing assignments collaboratively has been shown to enhance the students' interaction, lower anxiety in completing the tasks, and raise students' self-confidence. [7] Hence, using Padlet in writing assignments will allow students to enjoy writing jobs and complete them on time. It is reasonable because if a teacher can apply Padlet in teaching writing skills and presenting writing assignments correctly, it will allow students to learn from each other and independently. Besides, it has a prospective motivation space for students and to increase their learning curiosity to write.

2 Method

This research employed a qualitative method, and the data were obtained from the participants through interviews and questionnaires, and other supporting data collected from the observation checklist and field notes. The research was conducted at SMA Negeri Model Madani Palu and involved 31 participants from eleventh-grade students and 1 English teacher. The data obtained from the teacher's consultation is the information on how she/he integrates the technology in teaching and learning, particularly in teaching writing recount text using Padlet media. The data collected from the students are several questions related to how their response and attitude toward the use of Padlet in the teaching and learning process, particularly in learning writing recount text.

All those data from the interview, questionnaires, observation, and field notes were analyzed descriptively. In order to find a valid data, this research employed Triangulation to cross check the validity of the data. Triangulation is also commonly known as multiple methods or data sources to developed comprehensive understanding about phenomena. Cross validity means to cross check the validity of the data gained from different participants or different data sources; in other words cross validity in Triangulation is to test validity through the convergence of information from different sources.

3 Results and Discussion

Padlet is an online application or virtual wall to be used for the interaction between students and teachers. During this current situation, where most schools still conduct the teaching and learning process through online platforms due to the outbreak of coronavirus pandemic, Padlet is one of the most suited media because it can facilitate the teacher and students' teaching-learning process, particularly in writing skill.

Before constructing or assigning the students to do the task, they are first introduced to the application of Padlet, such as how it's used and what its benefits toward the learning process, particularly in writing skill. Then students were trained to operate Padlet using their devices such as laptops, smartphones, or tablets.

The findings of the research present three kinds of data: the application of Padlet in the teaching and learning process, particularly in writing recount text; the effects of using Padlet on students’ learning performance; and the student’s response and attitude toward the use of Padlet in the writing process.
3.1 The application of padlet

Several superiorities of using Padlet media in the teaching and learning process, particularly in improving both aspects; students' learning skills, particularly in writing skills and students' learning elements such as collaboration, engagement, imagination, creativity, good relationship and self-evaluation.

Following is the teaching steps using Padlet application as media in the process of teaching and learning writing skills, particularly in writing recount text.

Table 3.1 The teaching and learning writing stages through padlet.

<table>
<thead>
<tr>
<th>Teaching stages</th>
<th>Teaching activities</th>
<th>Students response</th>
<th>Students learning elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>Instructing by writing it on the wall (pallet)</td>
<td>* The students read the teacher's instruction she posted on the wall</td>
<td>engagement, imagination, stimulating self-evaluation</td>
</tr>
<tr>
<td></td>
<td>List the words/phrases related to your individual experience in visiting exciting places.</td>
<td>* Students listed some words and phrases related to their personal experience visiting exciting places. They also embedded pictures and videos to support the words/terms they have listed and posted them.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Asking the students to construct a topic of individual writing</td>
<td>* The students construct a topic of the writing they will construct</td>
<td></td>
</tr>
<tr>
<td>Drafting</td>
<td>Instructing students to construct sentences.</td>
<td>* Students construct sentences based on their selected keywords (listed words/phrases) related to the topic.</td>
<td>engagement, stimulating creativity, imagination</td>
</tr>
<tr>
<td></td>
<td>Please construct the listed words/phrases into sentences.</td>
<td>* The students construct the sentences freely based on their personal experience attaching with imagine</td>
<td>cooperating</td>
</tr>
<tr>
<td></td>
<td>Please find an article or image to support your topic</td>
<td></td>
<td>self/peer evaluation</td>
</tr>
<tr>
<td>Constructing</td>
<td>Instructing students to construct the paragraph taking</td>
<td>* Students put the</td>
<td>engagement, exploring</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Students’ writing skill using Padlet was identified through five main writing components:

1) Planning, in this stage, the teacher-directed the students to the writing topic by administering some brainstorming questions dealing with the English words or phrases related to the students' experience. The purpose of this brainstorming activity is to explore students' English word mastery about their experience. The findings on
planning showed a significant result since all students could list words and phrases on the wall and constructed them into the writing topic they were going to make. [8] highlighted that Padlet is an influential media that facilitates project work, class discussion, and brainstorming. Similarly, [9] concluded that Padlet is a versatile online interactive tool that boosts learners’ creativity and enthusiasm to collect and share ideas. The use of Padlet in the writing process allows every student to participate and freely send their thoughts on the wall (Padlet site). They can post their writing or asking questions without feeling embarrassed because they may post them anonymously.

2) Drafting is the second stage in the writing activity. In this stage, again, the teacher instructed the students to recall the English words and phrases they have listed and asked them to construct them into simple sentences. The students were free to build more simple sentences before the teacher asked them to put them into a simple paragraph. The result of observation indicated high student participation in drafting activity. They enjoy drafting training by constructed two or more simple sentences and present those sentences on the wall so that all students can read them.

3) Constructing. Constructing in a writing activity means to arrange some simple paragraph. Before having been in the construction activity, the teacher asked the students to recall the sentences they constructed in the drafting stage. It was meant to make it easier to build a paragraph. In this stage, some students found it was difficult to arrange some sentences into a simple paragraph. They got stuck when they put sentences chronologically to write a recount text. This problem required more time for them to do a repetition to construct a well-arranged sentence in a meaningful paragraph. Some students even asked their classmates for suggestions to have good paragraph construction after they posted the section. Most students could present two paragraphs on the wall; even though there was still a small number of them, they were confused about arranging sentences into an acceptable section.

4) The fourth stage is revising. In the revising stage, the students modify the structure of the writing, content, sequence event, and the coherence among the sentences.

5) The fifth stage is editing. The edition changes the text by adding, deleting, and rearranging letters, words, sentences, and paragraphs. In this writing process, the students edit their writing by identifying mistakes in grammar, spelling, punctuation, and capitalization.

6) The last stage of writing is publishing. In this publishing process, the students posted their final texts or paragraphs they have constructed, the teacher corrected and scored them.

3.2 The effects of using Padlet on students’ learning performance

The use of educational technology media facilitates the teaching and learning process. The application of Padlet as one of the technologies media offers some effects to both teacher and students. The following presented data in (table 3.2) describes the impact of using Padlet on students learning performance.
Applying Padlet in the writing process from drafting to the final stage of publication generates the students’ motivation and self-confidence in learning; they are actively participating in the learning process. The presented data shows that a high result of students’ participation in English writing class using Padlet. It was also found that students have more chances to learn and to practice writing skills attentively. The findings [10] stated that the use of Padlet could enhance the student’s learning experience that allows them to engage with subject material.

The student’s motivation and participation in posting their writing shows a high result; they are encouraged to complete the task by publishing their work on the wall. They are enthusiastic about posting their job due to their curiosity to have the new experience of using Padlet as a learning tool in their writing exercise. Moreover, they have more chances to post their writing product to represent their developing writing creativity. They are experienced in posting their photographs, personal videos, links, or images on the wall.

Besides posting photographs, personal videos, images, and links on the wall, the students were also motivated to have corrections on their writing product based on peers’ evaluation and teacher’s correction. Peer feedback or peer evaluation is a crucial factor in raising students’ motivation.

The finding is in line with [11] pointed out that Padlet increased the learner’s motivation towards writing through peer evaluation, and it also improved their writing performance. [12] stated that the use of Padlet raised learners’ participation in the discussion process as it allowed them to have experienced authentic communication with a real audience, classmates, and teacher. Both of the studies above support the findings of the present study; improved on students’ learning elements, raised in student motivation, and the activeness of students’ participation in-class activities. All those aspects can positively affect students’ learning performance and English skill achievement, particularly in writing skill.

The finding on point 5 shows a medium result. The students do a self-assessment on their writing product and improve their writing skills by reading their classmates’ work. It can be
interpreted that the students do not like imitating others' work to correct on his/her own. The last finding shows a high result on the criteria in point 7 – they do the task cooperatively and collaboratively. The integration of technological learning tools in the teaching and learning process has made the most significant change in teaching method from the teacher-centered to student-centered. [13] The results of integrating technology learning tools have given many benefits to students. The study by [14] showed that the use of Padlet helps students enhance their skills, especially in writing, communication, and collaboration. The use of Padlet facilitates communication and cooperation among students.

3.3 The effects of using Padlet on students’ attitude and learning motivation

As mentioned previously, the use of Padlet media is beneficial to students' writing skills and positively affects students' attitude and learning motivation. The following table is the data presentation on how the use of Padlet affects the students' attitude and students' learning motivation.

<table>
<thead>
<tr>
<th>No.</th>
<th>Criteria</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I enjoy using padlet in my English writing learning process</td>
<td>SA 23</td>
</tr>
<tr>
<td>1</td>
<td>I feel comfortable to use padlet in the writing learning process and publish my work on the wall (padlet)</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>I feel confident in learning writing skill using padlet</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>I like posting photos, image, and videos on the padlet</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>I learn fast and continuously improve my writing by reading my friends' work (self-evaluation)</td>
<td>19</td>
</tr>
<tr>
<td>5</td>
<td>I can improve my writing according to my friends' comments (peer evaluation), and my teacher's correction</td>
<td>23</td>
</tr>
<tr>
<td>6</td>
<td>I can work together and collaboratively</td>
<td>26</td>
</tr>
<tr>
<td>7</td>
<td>I can easily interact with my classmates and teacher</td>
<td>25</td>
</tr>
</tbody>
</table>

Notes: Strongly Agree (SA), Agree (A), Undecided (U), Disagree (DA), Strongly Disagree (SD).
The findings in table 3.3 above relate to the student's response, attitude, and learning motivation toward the use of Padlet in the learning writing process. The study found that from 31 participants, 23 or 74% strongly agreed that “they enjoy using Padlet in learning English writing skill.” Meanwhile, six students or 20% of the total participants stated that they agree, and the rest 2 or 6% of participants could not decide whether they agree or disagree.

Based on the presented data in the table above, almost all students have no difficulties in applying Padlet in the learning process, even though they have no experience of using it before. The data showed that about 81% of the total number of participants strongly agreed that they feel comfortable using Padlet in the writing learning process. They can easily publish their work on the wall; meanwhile, only less than 10% are undecided with the answer.

Moreover, 68% of participants strongly agreed that they feel confident in learning writing using Padlet, and about 10% undecided with the answer. They were encouraged to post their report not only; as shown on the table above, 58% of participants also enjoy sharing their photos, images, or videos on the wall. So, it is reasonable to indicate that technology promotes student learning independently and helps them build their confidence in learning English writing skills.

As shown in the table above, 74% of participants strongly agreed that they could improve their writing based on their classmates’ comments and teacher’s correction. Participants can evaluate their work through peer evaluation and correction from their teacher. It is one of the advantages of using Padlet in teaching writing skills. The use of technology has improved students’ critical thinking skills. They are motivated to learn and develop their writing skills enthusiastically. [15]

The next research findings were that approximately 71% of participants strongly agreed that the use of Padlet makes it easier to interact with their classmates and their teacher. It is in line with [16] stated that using Information and Technology in teaching and learning will be more effective in education environments where teacher and learners can interact easily and exchange information and experiences. The interaction between students and their teacher will make the learning experience more effective and meaningful. Therefore, the students become more motivated to learn more, and in turn, they can improve their writing performance.

The last finding of the research was that the use of Padlet in studying writing skills could encourage students to work collaboratively. It was found that almost 85% of the participants stated that I could work together and collaboratively. It means that the students enjoy the learning process using Padlet because they can revise and edit their writing product.

4 Conclusion

Based on the research findings and discussion above, several superiorities of using Padlet media in the teaching and learning process particularly in improving on students’ learning skills (students’ writing skills) and students’ learning elements such as engagement, creativity, cooperation, and collaboration. The application of Padlet also offer some positive effects on students’ learning performance; the students become more actively in participating English writing skill class, and have experienced improving on their writing skill through self, peer evaluation and correction from their teacher. The use of technology makes the teaching and learning process become more interactive and increased the students’ motivation.
The use of Padlet in writing class help students not only in improving the students' academic writing skill but also more helping them to build up their soft skills such communication, collaboration, creativity and critical thinking, all those skills are categorized as one of the 21st-century learning skills; commonly called in four C; communication, collaboration, critical thinking, and creativity.

Acknowledgements. This work was particularly supported by Muhammadiyah University of Palu, Central Sulawesi, Indonesia.

References


[10] Ellis D. Using Padlet to increase student engagement in lectures CURVE is the Institutional Repository for Coventry University. 2015;29(February).


Covid-19 Effect on Economic Growth and Employment in Eastern Indonesia Area

MA Djirimu1, Andi Darmawati Tombolotutu2, Failur Rahman3, Sri Haryani4
{ahlis.djirimu66@gmail.com1, ittaahls97@gmail.com2, myfaels@gmail.com3}

Department of Economics & Development Studies, Faculty of Economics & Business, Universitas Tadulako, Jl. Soekarno Hatta KM 9, Tondo, Mantikulore, Palu City, Central Sulawesi 94148 1,3, Faculty of Economics & Business, Universitas Muhammadiyah Palu, Jl. Jabal Nur No.1, Talise, Mantikulore, Palu City, Central Sulawesi 94118 2,4

Abstract. Covid19.go.id data as of September 2nd, 2020 shows that in the Eastern Indonesia Area (EIA), including ten provinces. This increase indicates that the more tracing, testing, and treatment areas, the more case finding increases. Some areas need to be watched out because they experience a false sense of security. This study aims to determine the Covid19 effect on economic growth and employment in the Eastern Indonesia Area that began to be felt in the second quarter of 2020. This paper uses a comparative analysis technique. Relative analysis techniques among provinces in EIA allow this paper to compare the Covid19 effect on economic growth and employment in ten areas in EIA and dissect each region's strategies in overcoming Covid19 transmission and prevention. Comparative techniques are also useful for comparing key factors that can promote and accelerate economic recovery before, during, and after the Covid-19 pandemic.

Keywords: covid-19, economic growth, employment.

1 Introduction

The Covid-19 cases entered a new phase in mid-June, where the increase reached an average of over 1,000 cases per day. On average, 10 thousand specimens were tested per day, although the numbers were still below the World Health Organization (WHO) standards. The Special Capital District of Jakarta, East Java, and South Sulawesi are the three provinces with the highest Covid-19 cases in Indonesia. Based on data from the Ministry of Health as of June 15th states that in The Special Capital District of Jakarta, the total number of cases reached 9,120 people which represents 23 percent, Covid-19 data cases throughout Indonesia. The second place was followed by East Java with 8,063 cases or 21 percent and South Sulawesi with 2,941 cases or 7 percent. Then West Java with 2,623 cases or 7 percent, Central Java at 6 percent, and South Kalimantan reaching 5 percent of the national Covid-19 cases.

In early September 2020, the Covid-19 task force reported an increase in cases from more than 2,000 to more than 3,000 starting August 27th, 2020 [1]. This condition has not changed relatively. The number of cases in The Special Capital District of Jakarta reached 42,041 cases, or the proportion reached 23.3 percent. Then East Java reached 34,278 cases or 19 percent, and Central Java reached 14,428 cases or 8 percent. The South Sulawesi Province reached 12,194 cases or a proportion of 6.8 percent, followed by South Kalimantan with 8,416 cases or 4.7 percent, and North Sumatra with 7,124 cases or the proportion of 3.92 percent.
Overall, the proportion of covid19 case findings in these six provinces reached 65.7 percent. West Java is no longer included in the top six of Covid-19. However, we need to observe the Covid19 data from day to day.

Covid19.go.id [1] data as of September 2nd, 2020 shows that in the EIA, including ten provinces, Covid19 cases reached 28,946 people, the largest proportion in South Sulawesi reaching 42.13 percent of all cases in EIA. North Sulawesi Province occupies the second position with the findings of covid19 with 3,908 cases and Papua with 3,873 cases. Central Sulawesi Province occupied the lowest position with 245 cases or 0.85 percent. Empirically, this case's findings do not show the actual reality because the case findings depend on whether or not each province has been intensively investigating cases, especially in areas of traditional markets, offices, shopping centers, entertainment centers, ports, and airports.

The Government has issued Law Number 2 of 2020 concerning the Stipulation of Government Regulations instead of Law Number 1 of 2020 concerning State Financial Policy and Financial System Stability for Handling Pandemic of Covid-19 and the Context of Facing a Threat Endangering National Economy and Financial System Stability to Become Law. This regulation aims to take quick, urgent, and extraordinary steps against health problems and in anticipation of saving the economy from worsening conditions. The Government and Bank Indonesia adopted the State Financial Policy, which includes adjusting the National Budget deficit limit, using alternative budget funding sources, adjusting mandatory spending, shifting and refocusing the central and regional budgets, issuing Government Securities programs and loans for additional deficit financing, incentives, and tax facilities, as well as the implementation of the National Economic Recovery Program for the sustainability of the real sector and the financial sector. On the policy side of the financial sector, policy instruments were taken, including expanding the authority of the Financial System Stabilization Committee (FSSC) and the scope of the FSSC meeting, strengthening Bank Indonesia authority, including buying long-term Government Securities in the primary market for handling Covid-19, strengthening the authority of the Financial Services Authority (FSA) and the Indonesia Deposit Insurance Corporation to prevent risks that endanger financial system stability and protect banking customers, strengthen government authority in dealing with banking problems and financial system stability due to the impact of Covid-19.

Covid-19 in Indonesia has made the economy contract in both supply and demand. Strategic sectors in the economy that are vulnerable due to Covid-19 are the tourism sector, including culinary activities, and tourism has stopped impacting 12 million workers. There is a potential for a decline of around 30 percent of the output in this sector in the trade sector and will impact 19.9 million workers. The manufacturing sector, incredibly light and heavy manufacturing such as garments, footwear, automotive, and electronics, experienced demand shocks for export products and luxury goods that threaten more than 8 million workers. The agricultural sector's impact, particularly in the food crop and plantation subsectors, threatens around 29.5 percent of the total national workforce.

Covid-19 with the “severe” category can cause unemployment in 2.92 Indonesians. In the “very severe” scenario, covid-19 could create 5.23 unemployed people, or the open unemployment rate will increase from 5.28 percent in 2019 to 7.33 percent in the severe scenario 9, respectively. 02 percent in a very demanding scenario. Furthermore, the poverty rate is estimated to increase from 9.41 percent in 2019 to 9.88 percent according to the chubby scenario and 10.98 percent according to the weighty scenario.

At the regional level, data from the Central Statistics Agency shows that of the 15 provinces sampled, namely North Sumatra, West Sumatra, Riau Islands, Lampung, Banten, West Java, Central Java, Bali, South Kalimantan, East Kalimantan, North Sulawesi, Sulawesi
Central, South Sulawesi, North Maluku, and Papua, only the province of Lampung still shows a positive growth of 2.87 percent because it relies on the agricultural sector. On the other hand, fourteen other provinces experienced a contraction, with the largest contraction in North Sulawesi at -12.48 percent.

On the production side, four provinces experienced an economic contraction in the agricultural sector, namely West Sumatra (-0.69 percent), Bali (-6.14 percent), North Sulawesi (-11.54 percent), Central Sulawesi (-1.53 percent), and Papua (-4.72 percent). In the mining and quarrying sector, out of 15 provinces, 13 provinces experienced a contraction, except for Banten and Central Java. In the manufacturing sector, 11 regions experienced a contraction, except North Maluku, Central Sulawesi, East Kalimantan, West Java; Meanwhile, in the transportation and warehousing sectors, the fifteen sample provinces experienced contraction. In the accommodation and food and drink sectors as indicators of the tourism sector's functioning, 11 of the 15 sample areas experienced contraction.

On the expenditure side, during the first quarter of 2020 against the first quarter of 2019, nine regions experienced a contraction in public consumption. Public consumption is the driving force for the regional economy's functioning and is expected to create a backward and forward linkage for the digital food and beverage industry. Besides, government spending contracted in all regions, and Gross Fixed Capital Formation as an indicator of investment in the regions contracted in 13 regions, except for South Kalimantan and North Maluku. On the foreign trade side, exports contracted in twelve regions and imports contracted in eight regions. On a more micro side, the exchange rate of farmers is getting below 100. This means that farmers' welfare decreases, “especially in nineteen provinces, especially South Sumatra, Bali, Central Sulawesi, and South Sulawesi” [2].

The 2020 World Bank study on public spending review in Indonesia in 2020 shows six problems in public spending in Indonesia. First, the limited fiscal space for development resulted from low state revenue collected from taxes and very minimal subsidy spending for the poor. Second, systemic constraints in various economic sectors hinder efforts to improve the quality of spending. Third, there is an inconsistency between planning and budgeting, especially in the budgeting orientation. Fourth, there are challenges in coordination between various government agencies and private institutions. Fifth, there is no performance incentive in fiscal transfers between government agencies. Sixth, the existence of insufficient information systems and constraints involving private participation [3]. Based on the background, the problem is formulated on how covid19 affects EAI's economic growth and employment. This study aimed to analyze the impact of covid19 on economic growth and employment in EIA.

2 Literature

A scientific article entitled The Global Macroeconomic Impacts of Covid-19: Seven Scenarios, "written by Warwick Mc Kibbin and Rosen Fernando. Both are from the Australian National University (ANU), the Brookings Institution, and the Primary Research Center for Population Aging (CEPAR). The two authors formulated seven scenarios to measure the global economic impact of Covid19. They use the G-Cubed multi-country model or epidemiological models in economic calculations. The seven scenarios are built based on a historical approach to pandemic events in several countries and several years ago using economic methods that are too technical when described in this article [4].
First of all, Covid-19 has a significant impact on the job market because of the potential and competitive levels of mortality and morbidity for the population. For China, as the epicenter of covid19, the impact on providing employment has reached an average decline of 15.86 percent. The contagion effect of Covid-19 on average depends on each of the seven-country scenarios, namely three high categories and three low categories, and one moderate category. The analysis uses a vulnerability Index, which uses three components: the mortality rate due to infection, the morbidity rate due to non-infection, and an increase in morbidity due to the infection's impact on family members. The negative impact of the spread of Covid-19 in other countries beyond health is through human movement transmission through land, air, sea, and trade transportation. This phenomenon is reminiscent of history when the "Black Death" pandemic or black death hit Europe starting in October 1347 after 12 Genoese merchant ships docked at the Port of Messina, the Sicilian Islands spreading bubonic plague which resulted in the loss of a third of Sicily's population.

Second, there is an increase in the cost of doing business in all economic sectors, which disrupts the production network in all countries the United States as the benchmarking of the world's most considerable economic power. The equity risk premium is measured by referring to the components of the population mortality rate and the Country Risk Index. The components of the Country Risk Index include the Governance Risk Index, the Financial Risk Index, and the Health Policy Risk Index. Country Risk Index consists of political, economic, and financial sub-components. Political variables consist of government stability, such as the prevalence of conflict, corruption, and law enforcement. Sub-components of per capita Gross Domestic Product (GDP), real GDP growth rate, and inflation rate are economic variables. Meanwhile, the financial component contains balance sheets of exchange rate stability and international liquidity between countries. The results show that India, China, Indonesia, and other oil and gas producing countries, as well as the rest of the countries, have risk fluctuations in the top 2 compared to other countries that are under two, such as Australia, Brazil, Germany, France, England [5]. Third, the effect on production costs, especially on inputs from the trade, land, sea, and air transportation sectors, is enormous. The seat occupancy rate for air transport has decreased by up to 70 percent despite slashing domestic and international airline prices.

Fourth, the impact on consumption patterns. The decline in the consumption pattern of necessities shifting to a health consumption pattern as a consequence of changes in income and prices, which are eroded by the behavior of "taking a profit" amidst the suffering of other residents affected by Covid-19. Also, the impact of Covid-19 is through the transmission of income and wealth. The pattern of people's behavior directs their income to future savings as a reserve for health anticipation. America's experience shows that during the H5N1 pandemic, Americans' consumption pattern in the economy was affected by 3 percent according to the G-Cubed model scenario. Economic turmoil in each country and each sector, such as energy, mining, agriculture, durable goods manufacturing, non-durable goods manufacturing, and service sectors. In the energy sector, the most significant impact was on Russia at 54 percent, the mining sector in China reached 50 percent, the agricultural sector in the United States and the rest of the world, the durable manufacturing sector in China and the United States reached 50 percent each, the manufacturing industry sector non-durable in the United States 51 percent followed by China 50 percent, and in the services sector, the enormous impact on the United States at 53 percent followed by China at 50 percent.

Fifth, fluctuation in consumption demand. Of the four scenarios, in the first scenario, the largest decline in consumption demand occurs in the United States by 1.06 times, followed by
Sixth, the impact on government spending. Practical experience shows that during the epidemic period, both SARS, MERS, H5N1, there was an increase in the health budget, especially for examinations at airports and seaports. An increase in health infrastructure investment prevents the spread of the pandemic. Scenario 4 shows that a pandemic causes a volatile increase in government spending by 59 percent in the rest of the world, 54 percent in other oil-producing countries, 52 percent in India, 50 percent in China, and 47 percent in Indonesia [6]

Seventh, the increase in the risk premium for all corporations operating in all economic sectors as a consequence of the pandemic's outbreak. The existence of private corporations, State-owned business entities, Regional-owned business entities that require their employees to Work From Home (WFH), work part-time, changing shifts has the consequence of reducing employee salaries, which it is feared will lead to termination of employment if the corporation can no longer cover its fixed costs such as employee salaries lease building, Social Security Agency Labor.

In the end, based on an economic analysis of the effect of the Convid-19 pandemic, it shows that there is an increase in country risk as a consequence of the vulnerability of macroeconomic conditions. In the short term, both the Government and the Central Bank play a significant role in ensuring that the economy disrupted by the pandemic continues to run [7]. The role of the Government in reallocating wasteful spending in Official Travel Warrant, routine activities without measuring, taking the primary duties and functions of fellow Regional Apparatus Organizations, dominant socialization and assessment rather than advocacy and community empowerment, seminars, meetings at the central and other regions rather than field visits in their regions, the development planning discussion (musrenbang) then complacent that its activities have been realized.

The financial system's turmoil was precisely followed by reducing the Bank Indonesia 7 days Reverse Repo Rate (BI7DRR) and a series of 104 trillion IDR Government Securities by Bank Indonesia to safeguard the economy from exposure to market sentiment and moral hazard. Self-quarantine of people under surveillance and patients under surveillance is an effective way to anticipate the arrival of an invisible enemy. Clean and Healthy Lifestyle, according to the findings of Levine and McKibbin, is a highly inexpensive and effective way to anticipate the spread of Covid-19, which erodes social and economic values [4]

Long-term efforts to anticipate the arrival of Covid-19 and its variants are essential for various countries to allocate their state budget for health insurance systems, especially health insurance systems in developing and developing countries where various infectious diseases originate. Global cooperation is an important point that focuses on public health in communities living on one planet earth [8].

Covid-19 has created various kinds of difficult issues to predict an end [5]. These issues include, first, how long will this crisis last? Second, how many workers are affected both temporarily and permanently? Third, how many countries are infected with Covid-19, and how much has the economy declined? Fourth, the effect reaches a peak? Fifth, how much has the economy lost due to Covid-19? Sixth, will the permanent and temporary effects of this crisis continue, and how will the business world organize its forces? Seventh, various public health policies pursued by various countries such as Italy, Taiwan, South Korea, Hong Kong, and China have impacted their economies, such as factory closures, travel restrictions, etc. How do these countries pursue a choice between public health policies and the impact of Covid-19 on the economy?
3 Method

The method used in this paper is descriptive analysis. This paper uses a comparative analysis technique. Comparative analysis techniques among provinces in EIA allow this paper to compare the effect of Covid-19 on economic growth and employment in ten provinces in EIA and dissect each region's strategies in overcoming Covid-19 transmission and prevention. Comparative techniques are also useful for comparing key factors that can promote and accelerate economic recovery before, during, and after the Covid-19 pandemic.

4 Results and Discussion


The figure above shows that only two provinces (in green) out of 34 provinces had a higher economic growth rate in the second quarter of 2020 than in the fourth quarter of 2019. In contrast, 32 provinces had a lower economic growth rate in the first quarter of 2020 than in the fourth quarter of 2019. Provinces South Kalimantan and Papua are coal mining areas and gold and copper mines.

Table 1. Economic Growth in Eastern Indonesia Area in 2019-2020 (Percentage)

<table>
<thead>
<tr>
<th>Description</th>
<th>2019&lt;sup&gt;a&lt;/sup&gt;</th>
<th>2020: Before Covid19&lt;sup&gt;b&lt;/sup&gt;</th>
<th>2020: After Covid19&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sumatera</td>
<td>4,6</td>
<td>4,8</td>
<td>-0,3-1,3</td>
</tr>
</tbody>
</table>
The existence of Covid-19 affects economic activity in more than 200 countries worldwide. In Indonesia, Large-Scale Social Restrictions has resulted in the stagnation of economic activity, population mobility in the transportation and warehousing sectors, tourism, Government, manufacturing, banking, and non-bank services other economic activities. This is shown by the decline in public consumption activities, especially in the informal sector. The decline in economic activity has resulted in unemployment and increased poverty. The Government is trying to pursue policies through consumption stimulus through social cushioning and business stimulus through Small Medium Enterprises (SMEs) and Ultra Micro (UMi) loans and industrial and State-owned Business Entities business stimulus. Unfortunately, this effort did not produce results in the second quarter of 2020 due to inaccuracies in implementation in the regions and a regulatory bottleneck.

Before Covid-19, the 2020 Government Work Plan target was estimated by the National Agency for Development Planning to reach 6.8 percent as the highest growth rate. Sumatra achieved the lowest growth rate at 4.8 percent. On the other hand, after the Covid-19 pandemic, this growth rate was at a negative interval of 0.5 percent to 2.1 percent in Sulawesi. The heaviest contraction in the economic growth rate was felt in Java due to the concentration of labor-intensive industries in various industrial areas. Meanwhile, in Sumatra, the tourism and oil palm plantation areas will feel the heaviest burden because the development orientation moves towards the food crops and horticulture and fisheries sub-sectors, which will soon be enjoyed short term.

In Kalimantan, the impact of Covid-19 will also be felt, especially in areas where farmers' exchange rate is below 100 points because rational traders will think about reserve for a particular time, the dominant food supply comes from Java and Sulawesi. Kalimantan is an island that relies on dual culture, namely coal and palm. The National Agency for Development Planning estimates Sulawesi to have the highest growth rate of 2.1 percent due to diversification of growth sources, namely the agricultural sector, food crops, horticulture, plantations, animal farming, and agriculture ferronickel base metal mining sector in Southeast Sulawesi and Central Sulawesi Provinces. However, some of the materials are also delivered from North Maluku to become final goods in PT. Indonesia Morowali Industrial Park (PT. IMIP) Industrial Area.

Besides, in Morowali Regency, there is also the PT. Transon Bumindo Resource Industrial Estate and PT. Wanxian Nickle Industry which is operating soon. Apart from being tourism destinations and the trade sector, both North Sulawesi and South Sulawesi play an essential role. According to the National Agency for Development Planning estimates, Maluku and Papua have economic growth of -0.3-1.5 percent and 0.0-1.6 percent. The mining, fisheries, tourism, and agriculture sectors in a broad sense are still the primary sources of growth—the economy.

<table>
<thead>
<tr>
<th>Region</th>
<th>2020 GDP (Rp)</th>
<th>2019 GDP (Rp)</th>
<th>Change (Rp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jawa-Bali</td>
<td>5.5</td>
<td>5.4</td>
<td>-0.5-0.8</td>
</tr>
<tr>
<td>Nusa Tenggara</td>
<td>4.5</td>
<td>5.9</td>
<td>0.0-1.3</td>
</tr>
<tr>
<td>Kalimantan</td>
<td>5.0</td>
<td>6.4</td>
<td>-0.4-1.8</td>
</tr>
<tr>
<td>Sulawesi</td>
<td>6.7</td>
<td>6.8</td>
<td>-0.5-2.1</td>
</tr>
<tr>
<td>Maluku</td>
<td>5.8</td>
<td>6.1</td>
<td>-0.3-1.5</td>
</tr>
<tr>
<td>Papua</td>
<td>-10.7</td>
<td>6.0</td>
<td>0.0-1.6</td>
</tr>
</tbody>
</table>

### Table 2. Covid19 Effect on Eastern Indonesia Area Economy (Percent)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>II</td>
<td>III</td>
<td>IV</td>
<td>I</td>
<td>II</td>
<td></td>
</tr>
<tr>
<td>SULAWESI</td>
<td>6.5</td>
<td>6.7</td>
<td>6.5</td>
<td>6.9</td>
<td>6.7</td>
<td>3.8</td>
</tr>
<tr>
<td>South Sulawesi</td>
<td>6.6</td>
<td>7.4</td>
<td>7.2</td>
<td>6.5</td>
<td>6.9</td>
<td>3.1</td>
</tr>
<tr>
<td>West Sulawesi</td>
<td>6.0</td>
<td>5.1</td>
<td>5.2</td>
<td>6.4</td>
<td>5.7</td>
<td>4.9</td>
</tr>
<tr>
<td>South East Sulawesi</td>
<td>6.4</td>
<td>6.3</td>
<td>6.4</td>
<td>6.9</td>
<td>6.5</td>
<td>4.4</td>
</tr>
<tr>
<td>Central Sulawesi</td>
<td>6.5</td>
<td>6.3</td>
<td>6.2</td>
<td>9.6</td>
<td>7.2</td>
<td>4.9</td>
</tr>
<tr>
<td>Gorontalo</td>
<td>6.8</td>
<td>6.7</td>
<td>5.7</td>
<td>6.5</td>
<td>6.4</td>
<td>4.1</td>
</tr>
<tr>
<td>North Sulawesi</td>
<td>6.6</td>
<td>5.5</td>
<td>5.2</td>
<td>5.5</td>
<td>5.7</td>
<td>4.3</td>
</tr>
<tr>
<td>MALUKU &amp; PAPUA</td>
<td>-9.6</td>
<td>13.1</td>
<td>-7.4</td>
<td>1.0</td>
<td>-7.4</td>
<td>2.9</td>
</tr>
<tr>
<td>Maluku</td>
<td>6.3</td>
<td>6.1</td>
<td>5.3</td>
<td>4.7</td>
<td>5.6</td>
<td>4.0</td>
</tr>
<tr>
<td>North Maluku</td>
<td>7.7</td>
<td>7.5</td>
<td>4.1</td>
<td>5.4</td>
<td>6.1</td>
<td>3.1</td>
</tr>
<tr>
<td>Papua</td>
<td>-18.7</td>
<td>23.9</td>
<td>-15.1</td>
<td>-3.7</td>
<td>-15.7</td>
<td>1.5</td>
</tr>
<tr>
<td>West Papua</td>
<td>-0.2</td>
<td>-0.5</td>
<td>2.9</td>
<td>8.3</td>
<td>2.7</td>
<td>5.1</td>
</tr>
<tr>
<td>SULAMPUA</td>
<td>1.6</td>
<td>0.6</td>
<td>2.3</td>
<td>5.2</td>
<td>2.4</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Source: Statistical Central Agency, 2020, data calculated by authors

Table 2 shows the impact of Covid-19 in Eastern Indonesia. In the first quarter of 2020, the impact of covid19 has not been felt. The rate of economic growth still shows a positive trend. The rate of economic growth ranges from the lowest 1.5 percent in Papua Province to 5.1 percent in West Papua Province as the province with the highest economic growth rate in the first quarter of 2020 in EIA. The Covid-19 effect began to be felt in the second quarter of 2020. In that quarter, eight provinces experienced a contraction in economic growth, namely South Sulawesi, West Sulawesi, Southeast Sulawesi, Central Sulawesi, Gorontalo, North Sulawesi, Maluku, and North Maluku. In eight provinces in EIA, the deepest contraction occurred in North Sulawesi, reaching -3.89 percent in the second quarter. On the other hand, a contraction in the economic growth rate was close to zero in Central Sulawesi, reaching -0.06 percent.

EIA's exciting thing is that during the three quarters, namely the first, second, third, fourth quarter, the rate of economic growth contracted respectively -18.7 percent, -23.9 percent, -15.1 percent, and -3.7. Percent. In 2019, the average economic growth rate contracted by -15.7 percent. This contraction impacts the decline in world copper only and is a lesson for regions that rely on regional revenues from the mining sector. Meanwhile, the economy of West Papua Province experienced contraction for two consecutive quarters, namely -0.2 percent in the first quarter of 2019 and -0.5 percent in the second quarter of 2019. This is a lesson for provinces in Sulawesi Island such as Central Sulawesi and Southeast Sulawesi, which the engine of growth in the mining sector is a sector that will not be renewable (non-renewable product). It is never too late for these two provinces to return to the sub-sector of food crops and horticulture, livestock, and fisheries. Sulawesi Island has the potential for post-Covid19 due to sectoral diversification, especially the mainstay of the agricultural sector in a broad
sense and the potential for sustainable fisheries because the regional economy's future is in rural areas.

The Covid-19 effect on employment in EIA is very clear from data from the Ministry of Manpower in July 2020. In EIA, workers reached 12.54 million people. Of these, 8.02 million people are informal workers or represent 64.01 percent of the total workers. The highest number of workers was in South Sulawesi Province with 3.91 million people, while the lowest number of workers was in West Papua Province with 454 thousand people. The highest proportion of informal workers in absolute terms is South Sulawesi, as much as 2.39 million or 61.11 percent. The largest proportion of informal workers from total workers is in West Sulawesi Province, reaching 72.63 percent in relative terms.

An economic recovery strategy can be launched in the EIA by refocusing and reallocating the budget in ten provinces. The people's economic recovery in Papua Province is carried out through two strategies, namely a supply-side-based strategy including the intensification of local taxes and levies, support for the worst-hit economic sectors, and handling of people's businesses and SMEs. The second strategy is handling the demand side of the regional economy. The form of policy instruments undertaken includes maintaining public purchasing power, implementing and synchronizing national and regional social safety nets, and reducing central and regional policy anomalies.

The multi-covid19 economic program launched by the Papua Provincial Government is the Capture Fisheries Production and Development Program, the Export Improvement and Development Program, the Small and Medium Industry Development Program, the Promotion Program, and Investment Cooperation. The social cushioning programs launched are the Housing Development Program, the Empowerment Program for the Poor, Remote Indigenous Communities and Other Persons with Social Welfare Problems, Social Welfare Rehabilitation and Service Programs, Workforce Productivity and Quality Improvement Programs, and Opportunity Enhancement Programs Work. The strategy above will deal with various issues

<table>
<thead>
<tr>
<th>PROVINCE</th>
<th>Sent Home</th>
<th>Work Termination</th>
<th>Number of Workers</th>
<th>Informal Worker</th>
<th>Percentage Informal Worker</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Sulawesi</td>
<td>17878</td>
<td>7089</td>
<td>3908181</td>
<td>2388319</td>
<td>61.11075715</td>
</tr>
<tr>
<td>West Sulawesi</td>
<td>1163</td>
<td>426</td>
<td>656380</td>
<td>476729</td>
<td>72.63003138</td>
</tr>
<tr>
<td>South East Sulawesi</td>
<td>4393</td>
<td>1114</td>
<td>1274067</td>
<td>804769</td>
<td>63.16535944</td>
</tr>
<tr>
<td>Central Sulawesi</td>
<td>5109</td>
<td>1500</td>
<td>1530259</td>
<td>967745</td>
<td>63.24060175</td>
</tr>
<tr>
<td>Gorontalo</td>
<td>1176</td>
<td>512</td>
<td>569166</td>
<td>334043</td>
<td>58.68990769</td>
</tr>
<tr>
<td>North Sulawesi</td>
<td>2576</td>
<td>1275</td>
<td>1156826</td>
<td>657887</td>
<td>56.87000465</td>
</tr>
<tr>
<td>Maluku</td>
<td>4014</td>
<td>756</td>
<td>697924</td>
<td>457838</td>
<td>65.59997937</td>
</tr>
<tr>
<td>North Maluku</td>
<td>728</td>
<td>383</td>
<td>526800</td>
<td>324800</td>
<td>61.65527715</td>
</tr>
<tr>
<td>Papua</td>
<td>1599</td>
<td>611</td>
<td>1764113</td>
<td>1350781</td>
<td>76.56998163</td>
</tr>
<tr>
<td>West Papua</td>
<td>2407</td>
<td>2343</td>
<td>454136</td>
<td>262118</td>
<td>57.71795233</td>
</tr>
<tr>
<td>EIA</td>
<td>41043</td>
<td>16009</td>
<td>12537852</td>
<td>8025029</td>
<td>64.00641035</td>
</tr>
</tbody>
</table>
that arise in the community in the form of the need to improve data on Social Assistance recipients, Synchronization of interventions between levels of Government in handling, Covid-19 swab test costs, corona cluster data in offices, budget allocation for handling Covid-19, transparency of handling budgets Covid-19.

In West Papua Province, the Government has allocated IDR 90.13 billion or 45.56 percent for health care, IDR 48.66 billion for the Social Safety Net or the proportion reaches 24.60 percent, the allocation of economic assistance (post-employment) reaches IDR 54.60 billion or the proportion of 27.60 percent, and the allocation of secretariat support reaching Rp.4.4 billion or the proportion reaching 2.24 percent. West Papua Province is undergoing four phases towards post-Covid-19 recovery, namely the pre-disaster phase, the emergency response phase, the emergency transition phase to recovery, which is currently underway, and the post-disaster phase (new normal). In the second quarter of 2020, West Papua Province became one of the two provinces in Indonesia besides Papua that experienced positive growth, including economic growth in the first semester of 2020. However, the unemployment rate increased at a time when poverty and inequality decreased.

In North Maluku Province, Covid-19 raises various problems in macroeconomics that impact the economic slowdown. First, there are layoffs in the mining, hospitality, trade, transportation, or loss of jobs in the Ministry of Micro, Small & Medium Enterprises (MSME) sector. Second, local governments do not have a disaster policy scheme. Third, refocusing was carried out massively; spending was stuck in the banking sector, resulting in restrained household consumption.

The North Maluku Provincial Government has taken a policy, namely, first, Large-Scale Social Restrictions to prevent the spread of Covid-19. Second, the Provincial Government activates Chasan Bousori's Hospital as a Covid-19 Hospital, amidst the uncertainty over the end of handling Covid-19. Third, the Provincial Government encourages the Municipal Government of Ternate to prepare a Regional General Hospital Ternate by utilizing the Ex-Mayor's Office as Ternate Hospital. Fourth, the North Maluku Provincial Government in implementing recovery programs and activities is still hampered by a complicated and convoluted budget disbursement mechanism that does not comply with the applicable Government Accounting Standards. Therefore it needs to be simplified with a certainty of spending by Regional Apparatus Organization and certainty availability of liquidity. Fifth, the policy to determine the implementation of Selection of Tilawatil Qur'an for 2021, which was set in North Maluku, so that the financing is handed over to the Central Government so that the Provincial Government of North Maluku can focus on economic recovery after Covid-19 in North Maluku Province. Sixth, the program for handling Covid-19 and economic recovery through the industrial Corporate Social Responsibility (CSR) program in North Maluku Province is carried out in an integrated manner with the economic recovery program prepared by the provincial Government.

We recommend that the post-Covid-19 SMEs recovery program be carried out first, identifying and mapping SMEs' actors affected by covid19. Second, designing a roadmap for developing SMEs according to the characteristics and diagnosis of the problem. Third, digitizing SMEs and traditional markets through cooperation with the Government and the private sector. Fourth, impose tax breaks (Motor Vehicle Tax, Land and Building Tax, Hotel Tax, Restaurant Tax) and Market retribution for SMEs, through tax exemptions for the next three years to recover business after Covid-19. Fifth, facilitate the management of building construction permits for SMEs players so that they can meet the requirements for accessing People's Business Credit in North Maluku Province. Sixth, reactivating the Central Government Program through the Sky Toll across the islands and regions of North Maluku to
implement online education, online inter-island markets, and support for digitizing SMEs and business actors in the community and village government.

The Maluku Provincial Government is refocusing and reallocating the 2020 Local Budget of IDR 177.66 billion. Of this total, health management allocation reached IDR 131.68 billion, or a proportion of 74.12 percent. Meanwhile, of these other amounts, the economic recovery allocation reached IDR 27.9 billion or the proportion of 15.70 percent, and the allocation for the social safety net reached IDR 18.08 billion or the proportion of 10.18 percent. Local Budget refocusing and reallocation, rationalizing spending on goods and services by at least 50 percent. Besides, the rationalization of capital expenditures of at least 50 percent is used for spending in the health sector and other matters related to health in the context of preventing Covid-19, including the provision of personal protective equipment for medical personnel, facilities, and service equipment for the community, and handling Covid-19 patients; The provision of social safety nets, among others, through the provision of social assistance to the underprivileged poor who have decreased their purchasing power due to the Covid-19 pandemic; and handling of economic impacts, especially keeping the regional business world alive, among others, through empowering micro, small and medium enterprises, as well as cooperatives in the framework of restoring and stimulating economic activity in the regions.

North Sulawesi Province has prepared IDR 521 billion for handling Covid19. Of this amount, IDR 96.5 billion is allocated for health spending such as ventilators, emergency stretchers, disinfectant booths, Personal Protective Equipment (PPE), rapid tests, isolation rooms, disinfectants, alcohol, vitamins, medicines, support for the Covid-19 task force. It is amounting to IDR 50.5 billion. Apart from the health sector, the Provincial Government of North Sulawesi has allocated IDR 45.5 billion for social assistance and a Social Safety Net distributed to 15 districts/cities. Currently, the assistance that has been distributed has reached 47,001 packages of staple foods that have been distributed to all districts/cities. North Sulawesi Province has implemented three strategies: first, the economic recovery strategy, especially the leading sectors. This strategy includes Recovery and Sustainability of Cooperatives and SMEs through credit restructuring and additional capital stimulus and others, development of Food Security through optimizing the development of the agricultural sector (including fisheries and livestock), Recovery Strategy and other business sustainability including traditional markets, market semi-modern, modern market, restaurant/restaurant and inn/hotel with standard health protocol.

The second strategy is to restore social safety nets by updating data based on the Social Welfare Integrated Data to identify affected people for social assistance, developing the effectiveness of Social Safety Net assistance through integrated planning and budgeting between the National Provincial District/City-Village/Village Governments. The third strategy, health recovery strategy, through efforts to meet the needs of Health Workers (doctors, nurses, and other health workers) in the handling of covid19 and non-covid19 patients in hospitals, health center, and open houses, efforts to fulfill infrastructure and facilities in handling patients covid19 and non-covid19 in hospitals, health center, and open houses, efforts to provide adequate shelters in all districts and cities, as well as preventive and promotive health development efforts.

Central Sulawesi Province faced various challenges during the Covid-19 pandemic. First, the distribution of production results was delayed due to the Regulation of the Indonesian Minister of Transportation related to land restrictions, sea and air transportation. Besides, there are several finished goods processing factories that have closed their businesses, resulting in an accumulation of production results. Second, 28 companies reduce the number of
employees. Based on reports, 1,430 employees have been sent home during the Covid-19 pandemic. Regional income from this sector in the form of regional revenue retribution has been reduced by IDR 750,000,000. Third, there are 1,426 industries affected by the Covid-19 pandemic, especially Small and Medium Industries in Central Sulawesi. Based on data from districts/cities, there are 3,186 workers affected by Covid-19. The strategy pursued is based on three treatment categories (handling health, economy, and social safety nets) as of July 31st, 2020, namely efforts to synchronize central/provincial/district/city interventions in handling Covid19.

Furthermore, the adjustment and implementation of health protocols in the New Normal Era. Collaboration of intra (government-non-government stakeholders in one region) and inter-regional (inter-regional cooperation) in handling Covid-19. Regional specific initiatives in handling Covid-19 by regions. Regional monitoring and evaluation framework in the policy for handling Covid-19 and supporting regulations and why they are needed. The problems faced in handling Covid19 are planning, implementation, regulation, stakeholder involvement, and other aspects.

According to Needs Through a Phase I shift of budget cuts for official travel and activities that collect large numbers of people 50 percent of the Regional Apparatus Organizations budget of IDR 112,816,638,596.81. The policy taken is refocusing the 2020 Local budget to support the handling of Covid-19, strengthening social safety nets, and economic recovery; Strengthening safeguarding (monitoring, control, and evaluation) of the implementation of policies on handling Covid-19 including health management, strengthening social safety nets and economic recovery so that it remains transparent, accountable, efficient and effective; Determination of proposed 2021 activities that truly support national priorities in the Government Workplan 2021, have leverage for regional economic recovery, and promote economic transformation; Strengthening the synergy of activities financed from the National Budget, Local Budget, Regional Transfer Funds, Village Funds, private investment, and other funding sources.

The Provincial Government of South Sulawesi has allocated IDR 112.85 billion to refocus and reallocate 2020 local budget funds. Of this amount, IDR 88.05 billion or 71.33 percent is allocated for handling health and safety. The rest is allocated for a Social Safety Net (JPS). Meanwhile, other allocations, such as SMEs venture capital stimulus, tax reduction, and exemption incentives, revolving fund timing incentives, were eliminated. The South Sulawesi Provincial Government has pursued a strategy of improving and maintaining public health quality in a promotional, preventive, and curative manner amid the Pandemic and Post-Covid-19 Pandemic.

The second strategy is to improve the quality and access to education that is and equitable as well as the useful link and match between the vocational education process and the development of the business world and industry; The third strategy, encouraging the growth and development of SMEs, the role of cooperatives in the regional economy and the role of Village-Owned Enterprises in maintaining economic stability at the village level; The fourth strategy is to improve the quality and productivity of the workforce based on skills and competencies of the workforce; The fifth strategy is to increase the provision of facilities and infrastructure for the agricultural, plantation, forestry, and aquaculture and fishery sectors through the provision of hygienic fishing and auction technology facilities and the provision of added value to the production of internal resources; The sixth strategy, improving the quality and availability of regional infrastructure, and encouraging labour-intensive programs that are in accordance with the authorities and systems of procurement of goods and services of government agencies; The seventh strategy, optimizing the economic potential of the islands,
through the provision of supporting infrastructure including means of transportation, boat moorings, clean water facilities, and development of electricity based on natural resource potential, and the development of SMEs of island communities; The eighth strategy, expanding cooperation and partnerships in investment, promotion, marketing. The ninth strategy is to increase the productivity of the regional economy based on natural resources, which is supported by adequate human resources; The tenth strategy, optimizing the prevention, countermeasures, and restoration of environmental damage; The eleventh strategy is to improve adaptation and mitigation capacity to climate change and optimize emergency response to potential natural and non-natural disasters; as well as the twelfth strategy, improving the quality of local government administration and public services.

The Southeast Sulawesi Provincial Government has allocated IDR 400 billion to refocus and reallocate the 2020 APBD for post-Covid-19 handling and recovery. Of this amount, IDR 421.52 billion was allocated for the economic handling of IDR 126.94 billion, handling the economic impact of IDR 60.79 billion, and providing a social safety net (JPS) of IDR 53.78 billion. Another portion of IDR 400 billion, namely Unexpected Expenditures, which reached IDR 158.48 billion, is allocated for 17 Regional Apparatus Organizations that carry out activities to handle covid19, and operational costs for task forces/task forces to accelerate the handling of Covid-19.

Various problems faced by the Provincial Government of Southeast Sulawesi, namely not all Regional Apparatus conducted a review/consultation with Government Internal Control Apparatus before the implementation of activities so that they could be supervised by the Supervision Team (Southeast Sulawesi Governor’s Decision Letter Number 274/2020); There are a number of Regional Apparatus that do not carry out optimal coordination in the implementation of activities so that they appear not transparent; Activity reporting by each Regional Apparatus is not optimal; There are delays in carrying out activities and even cancellations of activities are caused by relevance to Regional Apparatus Organisation primary duties or not fulfilling administrative requirements (Decision Letter Management, Cost Budgeting Detail, Standard Operational Procedure, Terms of Reference and implementation methods); Delays in regional apparatus in post-implementation reporting causes the recapitulation of activity reporting to be hampered; data on social assistance recipients is not accurate.

The solution to the various problems above is carried out through two strategies: the first strategy to supervise the implementation of activities resulting from refocusing on handling covid19. The Governor of Southeast Sulawesi establishes an Assistance Team for Planning and Implementation of the 2020 Local Budget Results and Reallocation Activities for Prevention and Handling of Covid-19. The second strategy is to synchronize the handling of Covid-19 between the Central and Provincial Governments: Synchronization of Covid-19 handling activities between the Central Government and the Provincial Government is carried out by following up on policies issued by the Central Government following provincial authorities, including: - Establishment of a covid19 Handling Task Force Covid-19 Provincial Level; - Refocusing activities and budget reallocation as well as revising the 2020 Local Budget; - Following up on the results of facilitation by the Ministry of Home Affairs regarding the preparation of the 2020 Revised Regional Development Work Plans by prioritizing activities for handling Covid-19; - Consultation with Ministries/Agencies regarding the acceleration of handling Covid-19.

Central and District/City Governments: Synchronization of Covid-19 handling activities between the Central Government and Regency/City Governments is carried out by following up on policies issued by the Central Government following district/city authorities, including:
- Establishment of a Regency Level Covid-19 Handling Task Force /City; - Refocusing activities and budget reallocation as well as revising the 2020 Local Budget; - Consultation with Ministries/Agencies regarding the acceleration of handling Covid-19. Synchronization of Provinces and Regencies / Cities: - Following up on the results of the facilitation of the 2020 Amendment Regional Development Work Plan by prioritizing activities for handling Covid-19; - Consultation and evaluation meetings between the Provincial Government and District / City Governments (at the level of the Regional Head and related Regional Officials) to accelerate the handling of Covid-19.


During the Covid-19 Productive and Safe Community Activity Period, to prevent and decide The chain of the spread of covid2019 which has the potential to occur as a result of people's travel into the Gorontalo Province is enforced: - Every traveler who enters Gorontalo Province must have an Entry Permit (SIM) with the requirements that he must have Rapid Test Results. The issuance of an entry permit (SIM) uses the "Around Us" application, which can be downloaded and activated on a mobile phone, to monitor the movement of everyone entering the Gorontalo Province. Besides, the Governor of Gorontalo issued Gorontalo Governor Regulation Number 41 of 2020 dated August 17th, 2020, concerning the Implementation of Discipline and Law Enforcement of Health Protocols as Efforts to Prevent and Covid-2019.

On the academic side, several recommendations deserve attention; first, the Covid-19 pandemic and social restrictions have had a broad impact on various business sectors (transportation, SMEs supporting the digitalization system, and tourism). Business actors in this field need to be invited to dialogue by the local Government to gather detailed information on their problems. If necessary, the method is to optimize the public institutions to intervene in the right types of policies to accelerate recovery from economic downturns. Second, Covid-19 will increase the number of poverty and unemployment numbers, especially in impacting sectors (transportation, SMEs supporting the digitalization system, and tourism).

There is nothing wrong with it. It is a moral obligation for the Government to provide capital assistance for SME business actors, bringing forth labor-intensive development policies for workers in the transportation sector and the tourism sector who have lost their jobs. Third, although social restrictions are no longer officially extended by the Government, the spread of Covid-19 is still ongoing. Even if Gorontalo is still a red zone, social restrictions are consciously needed from the community itself. This will impact the economic activities of the community, mostly day laborers and casual workers, which will worsen the amount of poverty.

In West Sulawesi Province, the most significant impact of Covid-19 in West Sulawesi Province comes from a decrease in household consumption in line with social restrictions implemented to reduce the spread of the virus. Another effect will come from a decrease in foreign and domestic tourists in line with the flight ban. Decreasing export demand for goods from West Sulawesi will also affect economic activity in West Sulawesi. Besides, various economic, social, and health impacts appear. First, the number of small-medium industries (SMIs) affected is 8,738 SMIs, with 661 workers being in work termination, potential losses
of 28 billion. A total of 816 SMEs and 64 cooperatives with 135 workers/cooperative members affected by covid19. A total of 1,266 workers were dismissed/ laid off from the hospitality sector, restaurants, SMEs, and industry. Second, there are changes and shifts in plans that will impact the development target (Target of Local Medium-Term Plans). Third, limited health infrastructure in handling Covid-19, Referral Hospitals for handling Covid-19 are only in Mamuju and Polewali Mandar. Fourth, poverty in 2020 in the medium scenario is estimated at 11.20 percent or 157,900 people, and the severe scenario is 12.40 percent or 174,250 people. Fifth, the Work from Home Policy (WFH) requires us to develop science and technology in the regions.

The strategy adopted by the Provincial Government of West Sulawesi is first, to increase the efficiency of the allocation of health spending for basic things. The second strategy is implementing the right policies in budget allocation in West Sulawesi. The third strategy is to fight for the special economic zone in West Sulawesi. The fourth strategy is to identify and strengthen leading sectors to curb economic contraction. The fifth strategy maps the current situation and condition of the education sector in West Sulawesi using an online learning model. The sixth strategy is to study the gap between the need and availability of education that involves partnerships or cooperation with external parties who care about the education sector. The sixth strategy is to improve social safety net recovery strategies such as reforming data on economic actors through improving the accuracy of data on economic actors (SMEs) and households that receive assistance, providing assistance focused on impoverished and near-poor families, providing provision for economic actors to adapt and reduce the impact of the Covid-19 pandemic. It is necessary to have a healthy recovery strategy, such as increasing the efficient allocation of health spending for basic things.

5 Conclusions

Based on the results of the analysis in the discussion, conclusions and policy recommendations can be drawn as follows. In EIA, the number of confirmed cases experienced an increasing trend from 72 cases to 15,242 cases between the first quarter of 2020 and the second quarter of 2020, or an increase of 21,069.44 percent. Meanwhile, between the second quarter and the third quarter of 2020, confirmed cases of covid19 from 15,242 cases to 79,566 cases or an increase of 422.02 percent. This shows that the ten provinces in EIA should be aware of this increasing trend because the peak of covid19 is not yet known. This increase indicates that the more tracing, testing, and treatment areas, the more case finding increases. Some areas need to be watched out for because they experience a false sense of security or a false sense of security, especially case findings originating from people without symptoms. The impact of covid19 in EIA on economic growth began to be felt in the second quarter of 2020. However, Papua and West Papua Provinces have not experienced a contraction like the other eight provinces in EIA. The Covid-19 effect on employment in EIA also began to be felt in the second quarter of 2020, to be precise, starting in April 2020. Until July 2020, data from the Ministry of Manpower showed that there was a phenomenon of laying off workers reaching 41,043 people in EIA, or the proportion reached 0.327 percent of 12,537,852 workers. Meanwhile, workers who experienced employment termination reached 16,009 people, or the proportion reached 0.13 percent. The economic crisis experience shows that the informal sector becomes a social safety net such as the SMEs and rural sectors. However, this time the pandemic has made the informal sector experience sluggishness in
EIA, whose burden is getting heavier because it accommodates 64 percent of the total workers in EIA or reaches 8,025,029 people.

References

Implementation of Muhammadiyah Cultural Da'wah
In the Education Sector in Palu City

S Kadir¹, Nuranisa¹, Gazali², A. Asikin³, E. Mulyadi⁴
{surnikadir2@gmail.com¹, nonaanisa51@gmail.com², miftahgzali@gmail.com³,
eritasarim@yahoo.com⁴}

Faculty of Teacher Training and Education, English Department, Universitas Muhammadiyah Palu,
Centra Sulawesi 94118, Indonesia¹,²,³
Faculty of Islamic Studies, Universitas Muhammadiyah Palu, Central Sulawesi 94118,
Indonesia⁴

Abstract. The presence of Muhammadiyah is theologically inherent and inspirational to the Kaili ethnic community who have embraced Islam because of Muhammadiyah's tajdid teachings, but sociologically at the same time it has a context that Muslims of Kaili tribe back in that time were still left behind. Muhammadiyah does pioneered the presence of authentic (pure) Islam and is oriented towards progress in its reformation, which directs the lives of the Muslim community of the Kaili tribe to be religious in a correct manner as well as a grace. The method in this research is qualitative descriptive method to produce descriptive data in form of written or oral data from respondents or actors observed. Method in this research is carried out by studying the literature from a number of books and relevant journals. Data were obtained through literature studies to make a descriptive analysis of the focus of the research on the Implementation of Muhammadiyah Cultural da’wahin the Education Sector in Palu City. The result of the research reveals that the role of Muhammadiyah Cultural da’wah in Palu City, especially in the sector of education brought significant changes since the land of Kaili formed in 1932 until now. Central character played by the figure of Rusdy Toana has been able to change the mindset of the Kaili people from adolescence to enlightenment. Muhammadiyah, has succeeded in supporting the Kaili Tribe community in the sectors of Education, Social, Religious Affairs, and Health. In the sector of education, Muhammadiyah has succeeded in establishing schools, such as: 11 Kindergartens, 5 Elementary Schools, 5 Junior High Schools, 4 Senior High Schools and 1 Higher Education with 8 Faculties plus 2 Post-graduates. Cultural da'wah in education sector is a mission to stay away from radical attitudes as an effort to realize Islam Rohmatan lil ' alamin.

Keywords: Cultural Da'wah, Muhammadiyah, Education

1 Introduction

This Word document can be used as a template for papers to be published in EAI Core Proceedings. Follow the text for further instructions on text formatting, tables, figures, citations and references.
1 Introduction

Vision in implementing Muhammadiyah education is to organize effective management and education networks as an advanced, professional and modern Islamic movement and to lay a solid foundation for improving the quality of Muhammadiyah education. The mission of implementing Muhammadiyah education according to (Nelly Yusra: 2018 (1)) is: (1) upholding the pure belief in monotheism, (2) disseminating Islamic teachings from the Quran and as-Sunnah, (3) realizing Islamic deeds in personal life, family and community, (4) making Muhammadiyah educational institutions the center of education, da’wah and cadre. Muhammadiyah primary and secondary education principles are based on Islam which is based on the Quran and al-Sunnah. Meanwhile, Muhammadiyah primary and secondary education aims is to develop various potentials of students to become human beings who believe in and have devotion to Allah SWT, noble, healthy, knowledgeable, creative, independent, democratic and responsible citizens of Indonesia for the realization of a truly Islamic society. Muhammadiyah throughout Indonesia in 2006. (1)

Supporting factors for the presence of Muhammadiyah in general is originated through some social, religious and moral anxieties and concerns. This social anxiety occurs due to ignorance, poverty and backwardness of people. Religious anxiety arises from seeing a mechanistic religious practice with no visible link to positive social behavior, as well as being laden with superstitions, bid`ah and khurafat. Moral anxiety is caused by blurring the boundaries between good and bad, appropriate and inappropriate. Apart from being a socio-religious movement, the Muhammadiyah organization is also known as the tajdid movement. Even though Muhammadiyah's approach varies according to its activities, Muhammadiyah itself calls as an Islamic movement and the da'wah of amar makruf nahi munkar, which has Islamic beliefs sourced from the Quran and as-sunnah. Therefore, Muhammadiyah has an identity: the Islamic movement, the da'wah movement of amar makruf nahi munkar, and the movement with Islamic beliefs originating from the Quran and the Sunnah. This identity has implications for the space and activities in multi-aspects of life, according to the needs of humans or society. (2)

Muhammadiyah as one of the largest socio-religious organizations in the country has entered at the second century. One of the challenges faced by Muhammadiyah was finding the right formulation to disentangle the relationship between religion and culture. Muhammadiyah debates the relationship between religion and culture on strategic discourse and the implementation of the concept of cultural da'wah. Cultural da'wah will be discussed in a more operational context. This shows how strong the internal desire of Muhammadiyah to change the da'wah strategy by accommodating more local traditions, culture and customs. The da'wah strategy by adjusting variety of religious life as a socio-cultural process is hereinafter popularly referred to cultural da'wah. (3)

Da’wah must be present in the efforts to enlight, to develop, to empower people. Because in essence da'wah is not only a process of introducing humans to their God, but also a process of social transformation, with a number of offers and alternative solutions for people in overcoming life problems they face. (4)

Da'wah is also a process of social transformation, as well as the comprehensive strategies and approaches that were developed by Rasulullah Saw when designing and mobilizing programs and agenda which contains the development or empowerment of the community and has a liberation perspective. In order to carry out such da'wah, the preachers must understand four main pillars of the da'wah approach strategy properly, as has been offered by Syukriadi Sambas, namely tabligh and ta'lim, irshad, tadbir, and tathwir. (5)
The cultural da’wah of Muhammadiyah in essence which is concerned with local culture is more centered on the elements of the activity system of culture, because this aspect is the most tangible and widespread cultural feature of society, apart from ideas and physical aspects. Therefore, it is necessary to choose the form of cultural activities to be used as media and targets of da’wah. In this connection, both purification and dynamism (renewal) can go hand in hand as a unity of ideas and actions from the cultural da'wah movement. (6)

Muhammadiyah is seen as having a very important role in spreading the ideas of Islamic renewal and having a very strong influence among the Indonesian middle class. Muhammadiyah can be said as a trendsetter and can be likened to a pulling locomotive for the carriages Indonesian reformist movement. This can be seen through the wide scope of Muhammadiyah reforms that are not only engaged in the level of educational reform but also in various other sectors such as pioneering the establishment of orphanages, hospitals, People's Credit Banks, Baitul Mal wa at-Tamwil and others as a characteristic of modern society. (1)

2 Literature Review

Muh. Syamsuddin: 2017 in a journal Muhammadiyah Movement in Grounding Multiculturalism Discourse a Normative-Institutional Foundation, that discursivity about the phenomenon of multiculturalism within Muhammadiyah is relatively recent. The climax was when there was a Tanwir session in Denpasar Bali in 2002, a big idea emerged about what is called "cultural da'wah" from a lengthy discussion involving a number of central administrators, academics, and representatives of the Muhammadiyah Regional Leadership, in the session. figures such as Kuntowijoyo, Abdul Munir Mulkhan, and Amin Abdullah provides their appreciative notes. (3)

ST Rajiah Rusydi; 2018, Muhammadiyah Education Concept, that Muhammadiyah Education and Teaching Muhammadiyah education as a professional charity has been implemented by K.H. Ahmad Dahlan and the founding fathers of Muhammadiyah education. The development of Muhammadiyah education is able to carry out the concept of professional good deeds.

The establishment of Muhammadiyah education was based on the theological motivation that humans would be able to achieve a perfect degree of faith and devotion if they had the depth of knowledge. The Quran very broadly explains the difference between those who are knowledgeable and those who are ignorant, those who are guided and lost. Humans will have high dignity if they have the depth of faith and the breadth of knowledge (Surah Al-Mujadalah: 11). Fearful faith will only be achieved by those who are knowledgeable (Surah Fathir: 28; Surah Az-Zumar: 9).

Theological motivation drives K.H. Ahmad Dahlan to provide education in the patio of his house and provides extra-curricular religious lessons at OSVIA and Kweekschool. K.H.'s actions Ahmad Dahlan organized this religious education as a form of shalib charity. Arifin (1987) in the Muhammadiyah Renewal Idea explained that as a result of Dutch colonialism, the Muslim community - and the Indonesian in general experienced two very acute educational problems. Departing from this reality, K.H. Ahmad Dahlan founded Muhammadiyah education in which religious and general subjects were taught. This Muhammadiyah education model is a combination of the Dutch model school system and the pesantren/boarding school. Muhammadiyah education is expected to be able to produce "ulama-intellectuals" or "intellectuals"; the "whole" generation is not the generation that
experiences "split personality." Religion, in the view of K.H. Ahmad Dahlan, must be in line and support each other with science. The existence of Muhammadiyah education at that time was a form of good deeds. K.H. Ahmad Dahlan was able to offer a new educational model as an embodiment (ashlah) from the conventional education of Dutch schools and Islamic boarding schools. Muhammadiyah education is also able to have "more perfect" generation than the alumni of Dutch pesantren and schools. (7) From an educational perspective, the presence of Muhammadiyah is partly due to the dualism of the education system. First, there was a colonial education system (Dutch education) which was schuralistic and discriminatory. It is said to be schuralistic because they only studied general knowledge and put religious knowledge aside. The education carried out by the Dutch colonial was also discriminatory. This means that not everyone can follow the education implemented by the colonial schools. However, the educational system managed by the colony was modern. (8) Surni Kadir: 2020 in the IJCC journal "Framing Kaili Tribe Culture in the Muhammadiyah Education Perspective," concludes that, the presence of Muhammadiyah in the land of Kaili is a pure and progressive Islamic movement presented not through individual channels, but an organizational system. Presenting an Islamic movement through an organization was a breakthrough at that time, when the Kaili people were still framed by a traditional culture that relied more on beliefs in anism and dynamism. The Muhammadiyah movement was a phenomenon at that time for the Kaili tribe community because Muhammadiyah in its renewal concept wanted to restore pure Islamic teachings based on the Al-Qur'an and the Sunnah of the Prophet who had to adapt to the original beliefs of the Kaili tribe community which were sourced from the teachings of their ancestors. The essence of da'wah in this case is to create and to provide direction for change. Changing the social and cultural conditions from injustice to justice, ignorance to progress-intelligence, poverty to prosperity, underdevelopment towards progress, change, improvement and development. This is in line with the history of the presence of Islam, with his da’wah the Prophet was able to move fundamental social changes from the era of ignorance to the era of Islam with all the dynamics of civilization. (9)

Based on some of the research results mentioned above, it can be concluded that Muhammadiyah cultural da'wah, especially in the sector of urgent education, is needed in the midst of society as an answer that Muhammadiyah carries out the mission of da’wah amar ma'ruf nahi munkar.

3 Method

This is descriptive qualitative research which the approach is based on phenomenology and constructivism paradigm in developing knowledge. This method reveals descriptive data in form of written or spoken/verbal from the respondents observed through literature study, books and relevant journals. Data were collected through literature study used to make the descriptive analysis towards research focus on the Implementation of Da’wah Culture of Muhammadiyah in the Field of Education in Palu city. The qualitative research is deepened regarding to social phenomenon or social environment such as behavior, phenomena, place, and time. Moreover, the social background is described fully in expectation that the researcher is able to develop basic questions such as what and how the phenomena happened, who is involved, when and where it is happened.
4 Results and Discussion

The researcher through this paper, would like to present the findings regarding the implementation of Muhammadiyah cultural da’wah in the education sector in Palu City, based on the results of research that has been carried out as follows.

4.1 Implications of the presence of Muhammadiyah in Palu

The presence of Muhammadiyah in Tanah Kaili is a new phenomenon that appears to be prominent from the pure and progressive Islamic movement that is presented not through individual channels, but through an organizational system. Presenting an Islamic movement through an organization was a breakthrough at that time, when the Kaili people were still framed by a traditional culture that relied more on beliefs in anism and dynamism. The Muhammadiyah movement was a phenomenon at that time for the Kaili tribe community because Muhammadiyah in its renewal concept wanted to restore pure Islamic teachings based on the Al-Qur'an and the Prophet's Sunnah, which was authentic, had to adapt to the original beliefs of the Kaili tribe community which were derived from the teachings of their ancestors. (10).

Muhammadiyah with the inspiration of Al-Qur'an Surat Ali Imran 104 wants to present Islam not only as a "transcendent" teaching that invites awareness of faith within the framework of tauhid alone. It is not just pure Islam, but does not care about life. Moreover, pure Islam is only partially understood. However, furthermore Islam is shown as a dynamic force for social transformation in the real world of humanity through the "humanization" movement (inviting all goodness), to follow the Qur'an and the sunnah of the Prophet. (11) (11) (11) (10) (11) (10).

4.2 Da’wah of Muhammadiyah in education sector in Palu

The forms of Muhammadiyah charity efforts in Palu City since its establishment in 1932 in the sector of Education are as follows. In the sector of education, it is hoped that Muhammadiyah in Palu City can continue to produce national cadres, who own qualified Islamic insight, to build better Indonesian nation in the future. The charities in the education sector that have spread throughout the city of Palu include the following:

1. Kindergarten are, TK ABA 1 to TK ABA 11 in Palu.
2. Elementary School Level / MI sbb :
   • MI Muhammadiyah Nunu ; St. Kalora No. 22
   • MI Al-Haq ; St.Suprapto No. 69
   • SD Muhammadiyah 1 Lere ; St.Tompi
   • SD Muhammadiyah Ujuna ; St.S. Wera
   • MI Aisyiyah ; St.Hangtuah
3. Junior High School Level/ MTs sbb :
   • MTs.Muh. Nunu : St.Kalora No. 22
   • MTs.Putri Aisyiah : St.Hangtuah
   • MTs. Muh.Al-Hak : St. Suprapto No. 69
• SMP Muh. Lere : St. Tompi
• SMP LB Muh : St. Tompi

4. Senior High School Level/MAN sbb :
• MA Muh. Nunu : St. Kalora No. 22
• MA Putri Aisyiyah : St. Hangtuah
• SMK Muh 1 : St. Soeprapto No. 69 Palu
• SMA Muh. Palu : St. Soeprapto No. 69 Palu

5. Faculties in Muhammadiyah University Palu :
• Master of Management in Islamic Education: St. Jabal Nur 01
• Master of Law: St. Hangtuah No. 114
• Faculty of Islamic Religion
• Faculty of Public Health
• Faculty of Education and Teacher Training
• Faculty of Law
• Faculty of Social and Political Sciences
• Faculty of Engineering
• Faculty of Agriculture
• Faculty of Economics. (13)

Muhammadiyah figures who have changed the nature of thinking of the Kaili tribe, they are as follows
1. Yandi Maranua, a Muhammadiyah figure who has changed traditions or culture such as the Balia, Pompaura ceremonies and others that reek of animism and dynamism in the Tavaili community, towards purifying Islamic teachings based on the Al-Qur'an and Hadith.
2. Yunus Sunusi; Peodal society, in the kingdom of Tavaili changes in idolatrous culture.
3. H.M. Ridwan; the power of faith and the development of knowledge (Purification of Tauhid), eliminating the culture of cultizing a person.
4. H. Rusdy Toana; A Muhammadiyah figure who is engaged in the socio-political and religious sectors, control government areas, one of the concrete efforts that have been made is the establishment of the Muhammadiyah College and the daily newspaper Mercusuar in Palu.
5. H. Tjatjo Thaha; Da'wah through education, reinforces Muhammadiyah beliefs through education.
6. Isak Arif: Da'wah for Moral Improvement through Education, one of his real efforts is to establish Al-Istiqlamah Modern Islamic Boarding School in Ngatabaru, Palu.

Syamsuddin H. Khalid, Modern Management Systems towards rational thinking. (10) In fostering a business with self-help initiatives and community funds itself, it cannot be denied that joy and sorrow come and go and vary so that KH’s message is remembered. Ahmad Dahlan "Long live Muhammadiyah and don’t make a living in Muhammadiyah". Because

4.3 Analysis of the role of Muhammadiyah da’wah in the education sector in Palu
Muhammadiyah with various activities carried out in Palu shows how serious this organization is in developing its potential. The number of charitable businesses that are
successfully managed shows the ability of the Muhammadiyah organization to carry out its potential. In education sector, for example, Muhammadiyah has succeeded in establishing schools starting from the Kindergarten Level to Higher Education. Even charity businesses in education sector and can be said to have broad access in the midst of society.

There are several factors that need to be considered in formulating a strategy, furthermore the strategy can actually lead the organization towards predetermined goals. Among the factors that need to be considered are: First Idiology, Second content, Third Mission, Fourth, effort or task pattern, the fifth environment, both external and internal. (12) Dewey views the individual as something functional in social life. Every individual in the view of progressivism is an organism that experiences a process. Because each individual is an integral part of the environment, events that occur in society, social interactions, feelings, thoughts and objects around them. If the learning environment is peaceful, pleasant, full of tolerance, then these conditions have an impact on the learning experience and psychological condition that each individual gets. (14)

Surni Kadir: 2018, Muhammadiyah cultural da'wah is built on three main pillars, namely: First, da’wah is enlightenment-oriented, secondly da’wah is oriented towards intelligence, and the third is da’wah that is oriented towards exemplary orientation. (9)

1. Da'wah oriented towards intelligence

Muhammadiyah organization in Palu affirms its presence as a mujaddid, reformer, cleanser from various superstitions, heresy, and khurafat and various Islamic amaliyah which are considered 'not straight'. The presence Muhammadiyah da’wah in Central Sulawesi, especially the city of Palu, in one and another case, touching or dealing with the da’wah role of three other Islamic organizations, namely (NU, Alkhaerat and DDI) which emphasized the character of Ahlussunnah wal Jamaah that had entered and 'controlled' Palu City first. This contact often causes conflict in the past at the early days of Muhammadiyah's established. Furthermore, other than verbal da’wah and religious lectures, da'wah bil qolam with various books and Muhammadiyah brochures, especially all Muhammadiyah charities are a manifestation of Islamic bil hal da’wah. The material he conveyed was Islamic teachings from the Al-Quran and Sunnah which in a certain format became the material for Al-Islam Muhammadiyah. For example, this is conveyed at all levels of education belonging to Muhammadiyah as a compulsory subject or subject for all its students.

Muhammadiyah Da'wah covers Da'wah for verbal bill, bill qolam, and bill hal. The da’wah verbal bil is carried out by religious lectures in the community, discussions at government agencies / offices, forum, and mosques; active inter dialogues on Radio and lectures on Safari Ramadan. Da'wah bil qolam is carried out by publishing the Mercusuar newspaper that was initiated by the late. H. Rusdy Toana. Meanwhile, da’wah bil hal is done in a variety of programs, starting from building economic enterprises, building Siti Fadilah Hospital, to various levels of education lines.

Based on the description above, the Management of Muhammadiyah and Aisyiah in Central Sulawesi Province, especially the city of Palu, have carried out many activities of da’wah to educate the ummah, either directly or indirectly through culture, and Aisyiah Central Sulawesi Province that committed to orienting itself towards educating the nation, and Aisyiah as Da'wah organizations that carry forward women's missions. The goal is to educate the nation, including to activate the reading and writing movement with the establishment of the library park movement in branches, regions and charities in the field of education as described above. Routine recitation activities carried out by Muhammadiyah and Aisyiah administrators are as follows:
• The Muhammadiyah / Aisyiah Leadership Study once a week is held in Muhammadiyah mosques, the study material is in the HPT regarding the latest information such as the procedures for worshiping etc.
• The recitation is routinely carried out by the Majelis Tablih Muhammadiyah and Aisyiyah once a month. The recitation is carried out by the branch level, there are several branches respectively.
• Baitul Aram for the management of Muhammadiyah charities by providing Muhammadiyah strengthening. The Dikdasmen Council (Primary and Secondary Education) implements Baitu Aram from the principal level to the service clan. As a prerequisite for joining a business practice, Baitul arqam Muhammadiyah teachers in the charity environment.
• Exciting art as a means of da'wah (Cultural institutions explore local culture combined with Islamic values. For example, in the TKTK, by releasing Islamic songs, the transfer of Islamic values, Islamic tales, and Islamic dances.
• Recitation students parents, both at the kindergarten to high school level, is held once a month by inviting all parents of students at all levels to participate in the activity.

2. Enlightenment-oriented Da’wah
Da’wah oriented towards intelligence includes in 3 activities, namely: First, invite people to accept Islamic guidance and increase the level of faith and devotion. Delivering Islamic teachings to all mankind anytime and anywhere. Second, Amar Maruf Nahi Munakar, trying to encourage and mobilize the ummah in good things includes various efforts that bring human benefit to all aspects of life, both in the social, cultural, political and economic fields. All areas of life must be mobilized for the benefit and welfare of human life. Third, Encourage and move human race to reject and leave evil things. It also eliminates all forms of evil that consoder as diseases in society. Da'wah of enlightenment-oriented, focuses on recitation (both from the branch to the regional level because that is the heart of the organization, this recitation movement is a hallmark of the existence of Muhammadiyah and Aisyiah in Palu. Muhammadiyah and Aisyiyah never get tired to give enlightenment da'wah that fill religious spirit so that bias does not occur and provide enlightenment to all people in ways that are in accordance with the spirit of Islamic teachings.

3. Model-oriented da'wah
A da'i should not just convey religious teachings without practicing them. Da'i should be the first to practice what he says. The ability of the da'i to become a real example of his people in acting is a wisdom that should not be abandoned. Real practice means that is immediately seen by the community, the preachers are not too difficult to talk a lot, but their movements are da'wah which is far more effective than just speaking. (15)
Muhammadiyah is an organization whose main mission is to do da’wah of amar maruf and nahi munkar, so its main target is to frame the Pumpura culture of the Kaili tribe community with pure Islamic teaching frame based on the Al-Qur'an and Sunnah of the Prophet, Muhammadiyah will target da'wah for several areas in the city. Palu, which is still staunchly defending the pumpura culture, maps out the targets of da'wah and the potentials that are targeted for the guidance of the ummah, which provides enlightenment for the Kaili tribe community in Palu. (16)
4 Conclusion

Theologically the Kaili tribe community, inspired by the presence of Muhammadiyah in Palu which is inherent and has an appeal to people who have embraced Islam because Muhammadiyah teachings is tajdid. Moreover, sociologically at the same time it has a context with the living conditions of the Kaili tribe's Muslims that were still left behind back in that time. Muhammadiyah has pioneered the presence of authentic (pure) Islam and is oriented towards progress in its reformation. It directs the lives of Muslim community of the Kaili tribe to be religious in a correct manner and bring grace to their life. The role of the Da'wah of Muhammadiyah in Palu City, especially in education sector, since its establishment in the land of Kaili in 1932 until now has been felt to have brought significant changes. The central character played by the figure of Rusdy Toana has been able to change the mindset of the Kaili people from adolescence to enlightenment. Muhammadiyah, has succeeded in supporting the Kaili Tribe community in Education education, Social, Religious Affairs, and Health. Muhammadiyah has succeeded in establishing schools, namely 11 Kindergartens, 5 Elementary Schools, 5 Junior High Schools, 4 Senior High Schools and 1 Higher Education with 8 Faculties plus 2 Post-graduates. Cultural da'wah in education is a mission to stay away from radical attitudes as an effort to realize Islam Rohmatan lil’ alamin.

References


Homeschooling, Obstacles, and Solutions In Palu Central Sulawesi

A Halik, Fatmah, Rahmawati

{abdulkhalik10@ymail.com}

Faculty of Islamic Religion, Islamic Education, Islamic Economic Law, Early Childhood Islamic Education, Universitas Muhammadiyah Palu, Central Sulawesi 94118, Indonesia

Abstract. Home-schooling is a developing education model in Indonesia that implements education for children at home by inviting a professional tutor. Home-schooling is motivated by various reasons: the desire of parents to provide the best education according to children's needs, talents, and interests; parents do not believe in formal education with various curriculum changes that become burdened to children in the learning activities. Meanwhile, homeschooling is considered to have weaknesses: the lack of interaction with peers and isolation from their social activities. This research was conducted through qualitative methods in which the data was collected through observation, interviews, and documentation. Data were analyzed in the form of data reduction, data presentation, verification, and conclusions. The results show that: first, the obstacle of Home-schooling in the form of no curriculum standardization but can be anticipated using the national curriculum standard. Second, the results of children's education cannot be appropriately measured. It is anticipated by following the education equality program packages, A, B, C, or collaborating with schools partner to measure the children's achievement. Third, providing opportunities for children to gather and play with their peers in the local community. Homeschooling is an alternative way of providing children with the best education according to their abilities and personality.

Keywords: Homeschooling, Obstacles, and Solutions In Palu Central Sulawesi

1 Introduction

Homeschooling is one of Indonesia's developing education models in implementing education for children at home through inviting professional tutors. As a model of children's education, homeschooling has something in common with school, among other things, both of which aim to deliver students to their best achievements (1). This education model is classified as informal education and has a clear legal basis stated in Law Number 20 of 2003 article 27 (a) informal educational activities carried out by families, and the environment in the form of independent learning activities (b) educational outcomes as referred in paragraph ( c) is recognized as being the same as formal and non-formal education after students pass an examination following national education standards (2).

Regulation number 129 elaborates that homeschooling stated in article 1 paragraph (4) homeschooling is an educational service process that is consciously and planned for my parents/family at home or other places in single, multiple forms. A community where the
learning process can take place in a conducive atmosphere with the aim that each unique potential of students can develop optimally (3) and explain comprehensively about the implementation of homeschooling.

Formal schools with their various problems cause parents to choose an alternative homeschool education, parents’ decision to choose homeschooling as their children's school, is considered to be a solution to controlling and supervising and giving full focus to children's learning conditions. Parents, assisted together with homeschooling organizers, have full power to control and supervise the learning system in homeschooling (4), because through homeschooling education parents can supervise education directly and can design education in accordance with the vision and mission of parents, children's needs, and children's talents and interests. So that it can create education that is in accordance with the conditions of each child, this cannot be done through formal education with a classical education system which requires children to follow school rules that pay less attention to the uniqueness of each individual child.

There are many reasons for choosing homeschooling, including the desire of parents to provide the best education according to the needs, talents, and interests of children and the distrust of parents towards formal education with various curriculum changes and learning achievement that less than optimal, It is burdensome for students, children as objects are not subjects that can include children's creativity and intelligence, both in terms of emotional, moral, and spiritual, and the parents' concerns about the negative external environment and the existence of parents' dissatisfaction with the formal school system (5), as explained by Asrori, the expectation of parents in choosing a favorite school for their children did not materialize because the expected results were not optimal (6). Wiwin Herwina also explained this; not all educational institutions can be suitable for children's education nowadays. It can be said as formal education has many limitations, for example, the friction in providing individual learning services, classical forms that cause teachers' lack of attention to children, a regulatory system that binding which is usually applied rigidly, etc. This can overwhelm and limit the creativity of students (7). Therefore, through homeschooling education, parents can control the learning side of children at any time and are assessed as an appropriate alternative educational model for children, with the aim that each child's unique potential can develop to its full potential (8).

However, some people suppose that the homeschooling education model negatively impacts children, especially in social aspects. They think that children who only study at home do not socialize with their peers. This, among others, was stated by Zul Alfiat that socialization became a general impression and perception that assessed that homeschooling students were not able to socialize well (9). This was further stated by Mega Anindita and Prahastwi Utari, who explained in detail that some people's concerns about homeschooling are myths. Among others, children are isolated from the environment and become anti-social individuals. Homeschooling cannot create a participatory community, and it will be difficult for children to get into college, etc. (10).

This educational model is increasingly in demand by the community. Although it reaps the pros and cons in society, the number of families that choose the homeschooling education model has increased. As explained by Zul Alfiat 2013, Google Trends search results reveal that Indonesia was in the top rank in the search for the keyword "homeschooling" in the region category, ahead of Australia, the US, and the UK (11). This is in line with the city of Palu, where homeschooling families are also increased. Therefore, the researcher is motivated to conduct this research, to identify the obstacles in running homeschooling and their solutions in Palu Central Sulawesi.
2 Literature

The main text should be written using Times New Roman, 10pt, fully justified. Italics can be used for emphasis and bold typeset should be avoided.

2.1. Agus Sadid, Homeschooling: Choices Amid Formal School Failure

This research focuses on the following aspects: homeschooling can be conducted in pure homeschooling, namely an independent homeschool model, curriculum, and planning developed without assistance from anyone; Learning outcomes of homeschooling programs are the result of equalization exams and partnered schools. Type of homeschooling that engaged with traditional schools partner works both in learning planning, implementation of learning, learning curriculum, and learning evaluation. Partnered homeschooling students will participate in each semester of the learning evaluation process and final exams held by partner schools (12).

2.2. Alfin Miftahul Khair and Galih Fajar Fadillah, Learning Styles of Homeschooling Children (Studies on Families of Homeschooling Actors)

This study focuses on aspects: learning methods used in homeschooling varied because they are adjusted to their developmental age. In practice, there are three learning theories used by Rahmad and Heni. The first is behaviorism. In this theory, it turns out that the children are excited to learn related to the motivation given and a conducive learning environment either at home or the environment around the house. The second is cognitive learning. This theory shows there are no problems for children in capturing the lessons given. Alif and Lean, like math and Dandy in terms of writing and reading, achieve significant progress. The last is a humanistic learning theory, showing that children can be independent in various ways, self-actualization, and self-confidence (13).

2.3. Siti Indarwati and Amriana, Implementation of Homeschooling Model in Efforts to Establish Child’s Independence (Phenomenology Study at Homeschooling Group Mutiara Umat Surabaya)

This research focuses on the following aspects: Group Mutiara Umat Surabaya homeschooling has implemented a Montessori model and a living book combined with the cultivation of Islamic teachings, implemented a national curriculum that focuses on six main subjects tested for national exams and combines with the typical umat Mutiara curriculum, namely the shaqofah curriculum. It focuses on religious lessons and is a type of community homeschooling. The supporting factors, cooperation among students' parents, provision of Islamic teachings or values in children, equipping children for independence and cooperation, and flexibility of learning places (14).

2.4. Dani Sukerti, Homeschooling Learning Model as Alternative Education (Case Study in Gorontalo District)

This study focuses on implementing a homeschooling learning model in Gorontalo District using the KTSP curriculum based on the Minister of National Education and is conducted once every semester. Homeschooling graduates have a certificate that is legally recognized to be used to continue to higher education. Different learning times in the learning program are flexible, depending on the child's request. The homeschooling learning model's
final assessment uses school grades, the process, and the parents' role. With the calculation of school and process (90%) and the role of parents (10%) (15).

2.5. In Purnamasari, Homeschooling in the Portrait of Education Politics: Ethnographic Studies on Homeschooling Actors in Yogyakarta

This study focuses on homeschooling is regulated by Law Number 20 of 2003 concerning the National Education System Article 27, Paragraph 2, as a formal legal position of homeschooling in society. Some of the problems include the regulations that have not been entirely accepted by all parties. Strategies can be carried out by conceptual or institutional development. The solution to the problem can be done by providing policies that accommodate all variants' interests, both single, plural, and community (16).

2.6. Siti Sholiha Nurfaidah, Understanding Homeschooling as an Educational Alternative for Children (Theoretical and Practical Studies)

Homeschooling is able to bridge problems related to individual differences in terms of character, intelligence, background, physical, mental development, interests, talents, learning styles and so on. Even the negative effects due to promiscuity that are often obtained from conventional school environments can be overcome through homeschooling (17).

2.7. Lisa Rahmi Ananda and Ika Febrian Kristiana, Case Study: Social Maturity in Homeschooling Students

Social maturity in participants is reflected in a positive self-concept, good self-direction, independence in learning where the participants themselves decide to homeschool with various considerations at their age at the time. In socializing, the participants are skilled enough to interact with people of different ages or of the same age. Meanwhile, in interacting with peers, participants experienced a few obstacles because they had different schedules in learning (18).

2.8. Danik Wijayanti, Differences in Creativity between Children with Formal Education and Homeschooling Children

Homeschooling does play a role in increasing children's creativity. Children who take homeschool have higher creativity than children who take formal education. Factors that are thought to influence the results of the study include programs organized by homeschooling, the role of parents as teachers and the role of tutors, adequate environment and facilities in homeschooling, the role of culture, children's adaptation to the school environment, test kits and children's conditions while working tests (19).

3 Method

This is flexible qualitative research, open, and can be conditioned based on the research field (14). Meanwhile, as quoted by Lexy J. Moleong, Bogdan and Taylor explain that qualitative methodology is a research procedure that produces descriptive data in the form of written or spoken words from people and observable behavior (15). Therefore, this approach is directed at the setting and the individual as a whole (holistically). Meanwhile, Galang Surya Gumilang explains that qualitative research is carried out in natural conditions and is a
discovery. In qualitative research, the researcher is the key instrument. Researchers must have broad theoretical and insight provisions to ask, analyze, and construct the object that been studied to be more transparent (16). This research was conducted in Palu City August-September 2020. There were two families at Ulujadi District, 1 Family at South Palu District, 1 Family at East Palu District, and 1 Family at North Palu District.

This research's data sources consisted of primary (17) were families who carried out homeschooling and secondary (18) data sources, namely: subject matter, activity documents, and other activities related to the implementation of homeschooling in Palu City. The data collection techniques used by the authors are as follows: Observation is the direct recording of symptoms that appear on the object of research using the five senses (19), Interview is a way of collecting data through contact or personal relationships between data collectors and data sources (20) and documentation. The researcher performs qualitative data processing with data processing techniques: coding, namely providing notes or signs stating the type of data source (literature books, legislation, or documents); copyright holder (author's name, year of publication). If the book is literature, notes or signs can also be placed at the bottom of the text, which is called a footnote with a serial number (22), Data reconstruction, is rearranging data in order, sequential, logical manner so that it is easy to understand and to interpret (23) and Data systematization, namely: placing data according to a boundary mathematical framework based on the sequence of problems (24). After processing the data, the researcher then checks the validity of the data by using data triangulation. The triangulation used is the triangulation of data sources.

4 Results and Discussion

Based on the research results, it was found that the obstacles in the implementation of homeschooling in Palu City were as follows:

4.1. Curriculum standard is not available for Homeschooling education

The result of the research shows that each family has a different set of educational programs due to different vision and mission as well as respective educational goals of parents; this is what causes the curriculum of homeschooling in Palu City are different because it is adjusted to the vision, mission and educational goals of the parents.

The differences in homeschooling curriculum are also caused by differences in the interpretation of the curriculum as stipulated in Permendikbud Number 129 of 2014 article 1 paragraph (8), the curriculum is a set of plans and arrangements regarding the objectives, content, and learning materials as well as the methods used as guidelines for implementing learning activities to achieve specific educational goals. It is further regulated in article paragraph (1) that the curriculum applied in the Homeschool refers to the national curriculum which is emphasized in paragraph (3) that the national curriculum as referred to paragraph (1) which is used can be in the form of a formal education curriculum or an equality education curriculum, taking more broadly or profoundly depending on the interests, potential, and needs of students. From these definitions and explanations, it can be understood that the curriculum used refers to the national curriculum in implementing education. For example, children aged 6-12 years are equalized to the elementary school curriculum but are still given the freedom to parents to improve the curriculum as explained in paragraph (3). Then reinforced in article 9 paragraph (1). Education is held as a systemic unit with an open and multi-meaning system.
This provides opportunities for homeschooling to renew the curriculum for parents to have the freedom to program the educational curriculum according to the vision, mission, and educational goals they want as long as the educational program follows the curriculum's meaning. For example, the homeschooling family in Ulujadi Subdistrict (H. Aliasyahdi Family) prioritizes moral education in the curriculum to form the character of their children's independence. In contrast, in South Palu District (Citrawan Family), families prioritize al-Qur'an education for their children. Likewise, in other families, all of them have a different educational curriculum.

4.2. Achievement of children cannot be appropriately measured, and parents must have educational knowledge and skills

Homeschooling has fundamental differences from traditional schools with a set of rules, study time, target achievements, educational models, educational evaluations, and so on, regulated by the government. However, in homeschooling education, all educational activities are entirely handed over to parents on the condition that parents must register their children to the local education office and sign a letter of commitment to be responsible for carrying out education at home (article 6 paragraph (2) b, Permendikbud No. 129 of 2014). Therefore, parents should support their children with knowledge and educate them to achieve educational goals. However, suppose the parents do not have these requirements and are negligent in carrying out their children's educational process. In that case, the educational achievements of the children cannot be appropriately measured.

Another obstacle is that not all parents have sufficient knowledge and skills in implementing educational programs. Besides, parents must also provide sufficient time for their children. This causes homeschooling to be less attractive to parents with limited knowledge and time; they cannot provide full attention to their children in providing a proper education.

4.3. Children do not socialize with their peers

Social factors have an essential role in shaping the social spirit of children. Children who attend traditional schools can use it to increase social insight by interacting with classmates. However, in homeschooling education, children have fewer peers/friends than children in traditional schools. Children only spend time with their parents and families. This can be a constraint on the social aspect; children will be isolated in the family environment. Therefore, parents need ingenuity and skill in building communication networks with neighbors around their house for their children to mingle with peers so that they have social experiences for their social character. The solutions to the problems of homeschooling in Palu City are as follows:

4.3.1. Apply national curriculum standards in establishing educational programs for children

The homeschooling education program is considered free education where parents are free to create educational programs for their children. However, parents still have to refer to the national education curriculum in creating education for their children because children will take equality examinations according to their level. Therefore parents should provide education that is in line with the child's education level. In this case, the homeschooling family in Palu City has a solution to put their children in certain course activities, for example,
English courses, Mathematics courses, Computer courses, and so on. It can support children's homeschooling education.

4.3.2. Participating in the educational equality package, A, B, and C

Parents are required to put their children on an equivalence exam so that education from homeschooling is recognized. In Indonesia, the equivalent education program is known as the Package A program, which is equivalent to Primary School, Package B is equivalent to Junior High School, and Package C is equivalent to Senior High School, as described in articles 10 and 11 Permendikbud Number 129 of 2014. Parents and children do not need to worry that as long as they have taken the equivalence exam program, they will get recognition guaranteed by the government, as explained in article 4 paragraph (1). Home school education results are recognized as formal and non-formal education after students pass the exam following national education standards. (2) Every person who has received an award equal to formal and non-formal education results as referred to in paragraph (1) has the same and equal eligibility rights to register at a higher education unit or enter the workforce.

Besides, parents can also build partnerships with specific schools to measure children's education. Children can take exams at these schools, such as the Semester and National Examinations because they have been registered with the Local Education Service and have obtained a number. National Student Parent (NISN) that can be considered equal to students at that education level.

4.3.3. Provide opportunities for children to gather and play with their peers

Children have a world filled with various social experiences with their peers. Therefore, parents' efforts in providing the social experience for children are to provide opportunities for children to hang out with their peers in the community. For this reason, parents need to arrange a gathering and playing time for children so as not to interfere with their learning activities. Children can also invite their friends to participate in activities at home to build good communication and interaction.

5 Conclusion

Homeschooling education has obstacles in its implementation, and these obstacles need to be well handled, so it will not obstruct the education process. Obstacles in the implementation of homeschooling are as follows: first, in the form of no standardization of the curriculum, they are anticipated by using the national curriculum standards to determine educational programs for children. Second, the results of children's education cannot be appropriately measured. It is anticipated by following the education equivalence program packages, A, B, C, or in collaboration with partner schools. Then the educational achievement can be measured at the same education level. Third, children who do not socialize with their peers are anticipated by providing opportunities to gather and play with their peers in the community by arranging children's gatherings and playing time. This shows that the findings in this study support the findings of previous studies and refute the notion that homeschooling can make children less social with minimal social life. Through homeschooling, parents can create outstanding education with dedicated teachers/tutors and develop education according to their abilities and personality.
References

[2] Undang-Undang Republik Indonesia Nomor 20 Tahun 2003 Tentang Sistem Pendidikan Nasional
[4] Fitriani, Implementasi Pembelajaran Sejarah di Homeschooling pada Program Distance Learning (Studi Kasus di Homeschooling Kak SetoTangerang Selatan 2015), Jurnal Jurnal Pendidikan Sejarah Vol.5 No.2 Juli 2016, h. 69
[8] Ade Muslimat, Homeschooling sebagai Pendidikan Alternatif Proses Belajar-Mengajar dalam Pendidikan, Jurnal Studi Gender dan Anak Vol. 3 No. 1, Januari-Juni 2016, h. 95
[9] Zul Alfiat, Homeschooling; Pendidikan Alternatif di Indonesia, Jurnal Visipena, Volume 10, Nomor 1, Universiti Sultan Zainal Abidin, Terengganu Malaysia, Juni 2019, h. 52
[14] Siti Indarwati dan Amriana, Implementasi Model Homeschooling dalam Upaya Membentuk Kemampuan Anak (Studi Fenomenologis di Homeschooling Group Mutiara Umat Surabaya), Eduusiana: Jurnal Manajemen dan Pendidikan Islam, Volume 7 Nomor 1 tahun 2020, h. 14
[17] Siti Sholiha Nurfai dah, Memahami Homeschooling sebagai Alternatif Pendidikan bagi Anak (Kajian Teoritis Dan Praktis), Vol 01 No 01 Tahun 2020, h. 59.
[31] Abdulkadir Muhammad, Hukum dan Penelitian Hukum, Bandung: Citra Aditya Bakti, 2008), h. 126
Student Errors in Completing Mathematical Story Problems Based on Watson's Criteria During Pandemic COVID-19

Malim Muhammad
{malim.muhammad@gmail.com}

Department of Mathematics Education, Faculty of Teacher Training and Education, Universitas Muhammadiyah Purwokerto

Abstract. This study aims to describe students' mistakes in solving story problems based on the Watson Criteria. The material used in this study is a two-variable linear equation system and was implemented at SMP Negeri 1 Kembaran. This type of research is a qualitative description. The subjects of this study were students of 7th grade class who were selected through purposive sampling technique. Students are grouped into three groups, namely groups of students with high, medium, and low learning achievement. Three students were selected from the three groups. Data collection techniques using written tests and interviews. The data validation test used technical triangulation by comparing the results of written tests and interviews. The results showed that 1) high learning achievement students made mistakes in the response level conflict stage, missing conclusions, missing data, and indirect manipulation; 2) student learning achievement is making mistakes at the stage of the problem of skill hierarchy, response level conflict, missing conclusions, missing data, and indirect manipulation; and 3) students with low learning achievement made mistakes at the stage of incorrect data, skill hierarchy problems, inappropriate procedures, response level conflicts, missing conclusions, missing data, and indirect manipulation.

Keywords: Student Errors, Watson's Criteria, Mathematical Story Problems, COVID-19

1 Introduction

The learning process in schools is the best effort to increase knowledge and skills. In addition, many students think that school is a very fun activity, they can interact with each other. Schools can improve students' social skills and social class awareness. But now the activity called school has stopped suddenly because of the Covid-19 interference. For Indonesian families is a big surprise especially for the productivity of parents who are usually busy with work outside the home. Likewise with the psychological problems of the children of students who are accustomed to face-to-face learning with their teachers. Mathematics has a big role in everyday life, it can be seen that when learning mathematics, someone will learn to plan, decide, and anticipate problems that come [1]. In solving mathematical story problems, cognitive skills, understanding of symbols, and understanding of sentences are needed [2]. Mastery of students' math skills needs to be analyzed [3]. It aims to determine the extent to which students understand the material given. Mathematical story problems related to everyday life [4]. Mathematical story problems are a problem that can help students apply mathematical concepts in everyday life [5].
In addition, mathematical story problems are mathematical story problems in the form of narratives related to everyday life that can be solved using mathematical sentences [6]. So it can be concluded that mathematical story problems are narrative questions that can be solved using mathematical sentences related to everyday life. Solving mathematical story problems requires the ability to understand problems and reasoning [7].

Problems commonly encountered by students are related to story questions [8]. In mathematics there are still many students who have difficulty solving story problems [9]. The difficulty experienced by students in learning mathematics is because students tend to memorize formulas more and do not know the concept [10]. The difficulties experienced by students in solving mathematical story problems cause students to make mistakes [11]. This happens because students cannot apply concepts in mathematics [12]. In addition, lack of knowledge can also cause students to make mistakes [13]. Lack of students' understanding of the questions can also be the cause of students making mistakes [14].

Analysis is the activity of investigating an event to find out the cause. Mistake or inaccurate action is an error against the right thing or previously agreed upon [15]. In addition, the error is a form of error against a predetermined procedure [16]. Based on this opinion, it can be concluded that an error is an error with the correct thing or procedure. Then, error analysis is an activity of investigating errors in matters or procedures to find out the cause. Identifying mistakes made by students is an important activity, because teachers can reduce mistakes made by students so that student achievement will improve [1]. In addition, by knowing the mistakes made by students, the teacher can find out the extent to which students understand the material that has been taught, especially mathematics [17]. The teacher can also give attention to students who need it [18]. Understanding the location of student mistakes can also illustrate how students' ability to master the material [19].

The reality in the field is that there are still many students who make mistakes in solving story problems, especially in the material on the Two-Variable Linear Equation System. Based on the results of interviews with seventh grade mathematics teachers, SMP Negeri 1 kembaran, based on the results of daily tests of two-variable linear equation system material, seventh grade students still have difficulty working on mathematical story problems, including difficulties in making mathematical models and difficulties in arithmetic operations. This makes students make mistakes in solving story problems. The number of mistakes made by students can show the abilities that students have [20]. In this study, the Watson criteria were used to determine the location of student errors in each step of the completion. There are 8 Watson's criteria, namely inaccurate data (inappropriate data), it is said to have made an error on this criterion if the student is unable to determine the required information. Inappropriate procedure is said to have made a mistake on this criterion if students cannot determine the method of completion to be used.

Data is missing (omitted data), it is said to have made an error on this criterion if in completion, students do not fully use the data provided in the questions. An omitted conclusion, it is said to have made a mistake on this criterion if the student is unable to write a conclusion but the result is wrong due to an error in the calculation. Response level conflict is said to have made a mistake on this criterion if a student experiences a calculation error in solving a mathematical model. Undirected manipulation is said to have made a mistake in this criterion if during the completion process, students have missed a settlement step. Skills hierarchy problem is said to make mistakes on this criterion if students cannot make mathematical models or students do not provide variables in the mathematical model created. In addition, it is said to have made an error on this criterion if students cannot answer the questions given. Based on the background above, the researcher limits and focuses the
discussion in this study. The research focus is on how to describe student errors in solving mathematical story problems based on Watson's criteria.

2 Method

This type of research is a qualitative descriptive study. This research was conducted at SMP Negeri 1 Kembaran with research subjects 7th grade. The purpose of this research is to describe how the students' mistakes in solving mathematical story problems based on Watson's criteria. The research subjects were categorized into 3 categories, namely high, medium, and low. From each category, 3 students were taken to be research respondents. Data were collected by means of a written test and strengthened by interviews. The data analysis technique used the Miles and Huberman Model in the form of data reduction, data presentation, and conclusion drawing. The data validation test used technical triangulation by comparing the results of the written test and interviews.

3 Result and Discussion

3.1 Students with High Learning Achievement

Based on the research that has been done, students with high learning achievement do not make mistakes on the incorrect data criteria. This can be seen when students can determine the information needed on the questions. In addition, at the time of the interview they can also explain what was written. In the criteria of the skill hierarchy problem, students with high learning achievement also did not make mistakes. It is proven when they are able to make mathematical models based on the information that has been obtained in the questions. Likewise, when interviewing, they can explain the process of making a mathematical model. On the incorrect procedure criteria, students did not make mistakes. Seen when they can determine the solution method to solve the mathematical model that has been made. They also know about the method chosen. It was proven when they interviewed that they knew briefly the definition of the method they had chosen and applied that method in solving mathematical models. On the response level conflict criteria, students with high learning achievement made mistakes. This can be seen when they can solve the mathematical models that have been created using the chosen method, but in the process of solving they make mistakes in the calculations. During the interview, they said that when they did their calculations they were not accurate enough that they made mistakes. This shows that students have made negligence which resulted in making mistakes.

In the missing conclusion criteria, students also make mistakes. Seen when students can write conclusions, but make mistakes in the completion process. When the interview can also mention the conclusions that have been made, but students make mistakes on the previous criteria, namely making mistakes when doing calculations so that students make mistakes on this criterion. In addition, students also made mistakes on the missing data criteria. This can be seen when in solving students do not fully use the information on the questions. This happens because students do not understand the questions and make negligence such as not being careful and forgetting to use the information on the questions. In the indirect manipulation criteria, students also made mistakes. It is seen when students miss or fail to write down the steps to solve it. When the interview also said that they thought they would finish quickly in solving
existing problems, so that students did not write down the steps for solving them. In addition, students also experience a lack of understanding of the meaning of the problem so that they cannot write down the steps to solve it. On the error criteria other than the seven categories, students with high learning achievement did not make mistakes. This can be seen when students can complete the questions given.

3.2 Students with Medium Learning Achievement

On the data criteria are not accurate, students' learning achievement is not making mistakes. This can be seen when students can determine the required information appropriately. Likewise, during the interview, students were able to explain the meaning of what they wrote. In the criteria of the skill hierarchy problem, students' learning achievement is making mistakes. It is seen when students can make mathematical models but are incomplete in writing down the variables. In addition, other errors can also be seen when students cannot make mathematical models correctly. When interviewing students said they were not thorough so they made mistakes not writing variables in the mathematical model that had been made and said they did not understand the problem so they could not make a mathematical model correctly. On the incorrect procedure criteria, students did not make mistakes. Seen when students can determine the method of completion to solve the mathematical model that has been made. During the interview, students can also briefly explain the definition of the method chosen and apply it to the process of solving a mathematical model. At the response level conflict criteria, students made mistakes. This can be seen when students make mistakes in calculations. Students said they were not thorough so they made mistakes. In the missing conclusion criteria, students also make mistakes. It is seen when students can write conclusions but make mistakes on the previous criteria, namely making mistakes in calculations.

In the missing data criteria, students' learning achievement is making mistakes on this criterion. This can be seen when in solving students cannot fully use the information in the questions. Occurs because students do not understand the meaning of the questions. In the indirect manipulation criteria, students also made mistakes. It appears that when in progress you cannot write down the steps for completion. Occurs because students do not understand the meaning of the questions. On the error criteria other than the seven categories, students did not make mistakes on this criterion. It is seen when students can answer the questions that have been given.

3.3 Students with Low Learning Achievement

On the incorrect data criteria, students with low learning achievement made mistakes on this criterion. This can be seen when students are unable to determine the required information appropriately. Likewise, during the interview, students only mentioned information according to what was written and said they did not understand the questions so they made mistakes. In the skill hierarchy problem criteria, students also make mistakes. Seen when students cannot create mathematical models. The interview also failed to explain the process of making a mathematical model properly. This happens because students do not understand the material. On the incorrect procedure criteria, students make mistakes on this criterion. This can be seen when students cannot determine the method of completion and it occurs because students do not understand the material. On the response level conflict criteria, students with low learning achievement also made mistakes. It is seen when students cannot write down the completion process of the mathematical model. This happens because students make mistakes on the previous criterion, which is not being able to make a mathematical model.
In the missing conclusion criteria, students make mistakes. Seen when students cannot make the desired conclusions. It occurs because students make mistakes in the previous criteria, namely they cannot complete the mathematical model. In the missing data criteria, students made mistakes when in solving the students could not fully use the information in the questions. Occurs because students do not understand the questions. In the indirect manipulation criteria, students with low learning achievement also made mistakes. This can be seen when students in progress cannot show completion steps. Occurs because students do not understand the questions. When the interview was also unable to explain the steps to solve it. On the error criteria other than the seven categories, students did not make mistakes. It is seen when students can answer some of the questions that have been given. Even though the answers written by students were not quite right.

4 Conclusion

Based on the results of the research that has been done, it can be concluded that high learning achievement students made mistakes on the response level conflict criteria, missing conclusions, missing data, and indirect manipulation. The mistakes made by students with moderate learning achievement were errors in the skill hierarchy problem criteria, response level conflicts, missing conclusions, missing data, and indirect manipulation. Low learning achievement students make all errors except those other than the seven categories. Errors that were made occurred in inappropriate data criteria, skill hierarchy problems, inappropriate procedures, response level conflicts, missing conclusions, missing data, and indirect manipulation.

References


Improving Academic Success Through Applied Learning Theories, A General Elective (GE) Course

O A P Tulabut, R S Mangalus, R N C Cruz, A B Gonzales, E L L Pare, I M C Evaristo, and C L M De Ala
{gonzales.abigail@auf.edu.ph}

Angeles University Foundation, MacArthur Highway, Angeles, 2009 Pampanga, Philippines

Abstract. Traditional schools often link academic success with academic achievement - identifying General Weighted Average as an essential indicator. More recently, however, educators have become interested in exploring the role of psychological constructs such as well-being and student engagement in academic success. The present study took a similar path by determining whether a newly designed General Education elective course for freshmen dubbed as Applied Learning Theories correlates with academic achievement, student engagement and well-being. Unlike most introductory and study skills courses, ALT is contextualized and integrates not only study strategies and test-taking attributes but also self-care practices. The course was structured to build transferable learning skills that will have a long-term impact on engagement, retention, graduation rates, and general well-being. Some of the course topics are managing procrastination, metacognitive learning strategies, achieving a growth mindset, self-management skills, and practicing self-care. Results showed that as students learn and engage in the subject, they appear to become more academically and cognitively engaged and competent. With the introduction of such concepts, students were able to develop positive emotions, sustain interest in challenging tasks, and find meaning and purpose in their academic pursuits while increasing their chances of academic success.

Keywords: academic success, applied learning theories, GE Course.

1 Introduction

Higher Educational Institutions play an important role in shaping academic success, especially that it is a metric for an institutions' performance. Most often, educational systems equate academic success with academic achievement. However, York, Gibson, and Rankin [38] argued the ambiguity of academic success, mainly due to its "amorphous nature." Their definition of academic success includes academic achievement, attainment of learning objectives, acquisition of desired skills and competencies, satisfaction, persistence, and post-college performance [38]. Traditional education gives credence to these factors in preparing students for future productivity. However, more recently, scholars have looked into psychological constructs that can promote academic success [7], such as well-being and student engagement.

University students have been considered an at-risk population since common behavior problems such as drug and alcohol use, internet addiction, and violence are associated with the age at which students start in College [30, 39]. Mental disorders such as anxiety, mood, and substance abuse, usually peak around adolescence to early adulthood [22]. These behavior
problems are due to various stressful experiences ranging from academic pressure, separation from family, individuation, relationship problems to work responsibilities [30]. Universities need to put a premium on enhancing protective factors such as well-being to help students overcome any distress that may impact academic success.

Well-being is a well-researched concept in psychology and has been found to have impressive and meaningful consequences. Martin Seligman identified five building blocks that enable humans to flourish, and these are positive emotions, engagement, relationships, meaning, and accomplishments [32]. Interestingly, trends in positive psychology have overflowed into education. It posits that schools should teach not only the skills of achievement but also skills of well-being, how to live healthy, purposeful, and meaningful lives [4, 33]. Seligman [33] elaborated that well-being is synergistic with better learning. More specifically, if students know how to tap into positive emotions, are capable of experiencing flow, proficient in cultivating positive relationships, engaging in activities bigger than themselves, and identifying clear goals, they can learn better and, therefore, be academically successful. More specifically, positive emotions broaden the scope of attention [17], induce efficiency in decision making, affect cognition, and increase learning outcomes [35]. In general, researches have shown that students with positive well-being are more likely to perform better and complete their studies [11, 39].

Equally important is student engagement, which has been identified as a construct essential to learning. It is manifested when students remain motivated to perform at optimal levels to maximize their competencies. Student engagement is a students' behavioral, cognitive, and emotional connection to learning [16]. Kahu developed a holistic framework of student engagement that depicted the antecedents and consequences of the interplay between student and institutional factors against the bigger socio-political context where students, faculty, and institutions are situated [21]. The framework was refined to include student experiences that occur in an educational interphase. The four elements in the interphase are self-efficacy, belonging, emotions, and well-being, stemming from the interaction between the students and the Institution [20].

Another student engagement model describes four facets: (1) Academic engagement, which refers to behaviors that directly contribute to academic achievement such as accomplishing homework and listening attentively in class; Social engagement, which involves mandated and nonmandated social behaviors that facilitate learning, such as following classroom rules and actively interacting with teachers and classmates in productive ways; 3) Cognitive engagement, which indicates behaviors that involve effortful and critical thinking for complex learning, such as advance reading and clarifying questions more comprehensively; and 4) Affective engagement, which deals with student involvement in programs that help them learn but also gain a greater sense of belongingness in school, such as joining extracurricular activities and participating in community extension project This multidimensional construct prevents poor student outcomes and has been found to have a positive relationship with academic performance [18, 26].

Higher education is responsible for meeting society's learning needs and allowing students to have avenues to be academically successful [12]. This responsibility is the latent intention of the Philippines' shift to K-12 education a few years ago. The K-12 curriculum serves as a more efficient teaching system that encourages student engagement, academic achievement, and "real-world" preparedness due to a more focused learning specialization than a congested general curriculum like the old Basic Education Curriculum (BEC). However, opinions on K-12 vary from ambivalence to acceptance [2], affecting different sectors in the country [1].

This educational reform also necessitated the creation of the College Readiness Standards (CRS) by the Commission on Higher Education (CHED). The CRS represents higher
education's intention to share with basic education the expectations for college learning [34]. This way, it assured that graduates of the K to 12 program would not need any remediation in entry-level undergraduate courses. On the contrary, research showed that senior high school graduates were less effective than BEC graduates in readiness and performance despite perceiving the K-12 curriculum as a positive development [36]. This finding affirmed what research documented about college eligibility not being synonymous with college readiness [3, 8, 19, 24].

Research has documented several ways to bridge this gap. To improve first-year college success outcomes, Universities offer multi-level initiatives to include orientation programs, optional introductory learning and study skills courses, first-year seminars, freshmen interest groups, and mentoring or coaching programs [31]. Hunter and Linder [15], as cited by Culver and Bowman [15], described that more often, scholars categorized these freshmen educational practices into either a (1) orientation and academic success seminars that provide resources to ensure ease of transition to college life or (2) academic inquiry-based seminars that practice metacognitive strategies in academic topics based on students or faculty interests. These practices are considered by the Association of American Colleges and Universities as "high-impact" and correlate with student performance [9]. However, there are mixed results regarding these practices' effectiveness for predicting college success and retention [15]. In addition, each program's activities lead to different psychological outcomes that purportedly lead to increases in academic and social integration, eventually leading to student retention [6].

To respond to society's changing learning needs and improve academic success among its freshmen students, Angeles University Foundation designed a General Education elective course, Applied Learning Theories (ALT), an orientation and academic success course. The subject was designed in part on freshmen study skill courses anchored on research-based learning strategies [19]. Unlike most introductory and study skills courses, ALT is contextualized and integrates not only study strategies and test-taking attributes but also self-care practices. Starting Academic Year 2019-2020, all freshmen were required to take this three-unit subject. The course is structured to build transferable learning skills that will have a long-term impact on engagement, retention, graduation rates, and general well-being. Some of the course topics are managing procrastination, metacognitive learning strategies, achieving a growth mindset, self-management skills, practicing self-care, and stress management.

The present study aims to determine whether ALT can predict academic success over time. ALT's contextualized nature, which is a blend of academic and non-academic correlates of academic performance, gives rise to the question of how effective it is in predicting academic achievement, student engagement, and well-being. The study's findings will be a basis for data-informed decisions towards providing students with opportunities to develop, learn, and succeed wholly. The following are the specific objectives of the first phase of the study:

1. Determine if engagement in Applied Learning Theories (ALT) is significantly associated with academic achievement.
2. Determine if engagement in Applied Learning Theories (ALT) is significantly associated with overall student engagement.
3. Determine if engagement in Applied Learning Theories (ALT) is significantly associated with psychological well-being.
2 Method

2.1 Research Design

This paper reports a preliminary analysis of the five (5) phase longitudinal, explanatory study illustrated in Figure 1. This study tests whether engagement in Applied Learning Theories is associated with academic success, psychological well-being, and student engagement. Likewise, data are collected during the Academic Year 2019-2020, the first year of the Applied Learning Theories (SSELECT) course.

![Diagram](image)

**Figure 1.** Improving academic success through ALT Engagement as mediated by psychological well-being and student engagement

2.2 Participants

The participants of the study were students enrolled in Applied Learning Theories (SSELECT) during the Academic Year (A.Y.) 2019-2020. They were recruited through their respective class instructors. A total of 1066 students completely answered all administered research instruments. These students will be followed to the expected completion of their undergraduate degree by A.Y. 2022-2023.

2.3 Research Instruments

2.3.1 Academic Success

Academic success was operationalized in Phase 1 of the study using the general weighted average (GWA). The final GWAs of students during the semester in which they are enrolled in the Applied Learning Theories (SSELECT) class will be requested from the Office of the University Registrar at the end of the academic year. Subsequently, measures of academic success will include retention rates, acquisition of desired skills and competencies, satisfaction, and employability.

2.3.2 Psychological Well-Being

The PERMA Profiler (PERMA) was used to examine psychological well-being. It is a 23-item scale measuring five psychological well-being domains: positive emotions, engagement, relationships, meaning, and accomplishment. The scale ranges from 0 suggesting "never",...
"terrible", and "not at all" to 10 implying "always", "excellent", and "completely". An example of a measure item is "How much of the time do you feel you are making progress towards accomplishing your goals?" The scale appears to have sound psychometric properties with a Cronbach's alpha ranging from .71 to .89 with evidence of convergent and divergent validity [10].

2.3.3 Academic Success Student Engagement

The University Student Engagement Inventory (USEI) was used to measure student engagement. According to Maroco et al. [27], it is a 15-item scale conceptualized as a second-order factor reflected by behavioral, cognitive, and emotional dimensions. The 5-point Likert scale ranges from 1, which is "never," to 5, which corresponds to a frequency of "always." The scale's psychometric properties are also acceptable, with a study obtaining a Cronbach's alpha of .80 with evidence suggesting sound convergent and divergent validity [5].

2.3.4 ALT Engagement

Specific engagement for Applied Learning Theories (ALT) was measured using the Applied Learning Theories Engagement (ALTEN) measure. According to Pare et al. (2019) [29], the measure contains 60 items: 30 items each for both the Rating Scale (ALTEN-RS) and the Engagement Checklist (ALTEN-CL). The ALTEN-RS checks the degree to which a student practices the theoretical concepts and tips covered in SSELECT and asks respondents to rate their practice on statements such as, "I follow a consistent format in note-taking.". Items are cumulatively scored and rated on a 5-point Likert scale varying from 1 to 5, which correspond to "never" up to "always," respectively. Meanwhile, the ALTEN-CL consists of mostly close-ended questions of differing formats (e.g., multiple-choice, rating) that ascertain ALT engagement in greater detail and produce nominal and ordinal data for demographic profiling. The 60-item instrument can measure overall engagement in Applied Learning Theories, which can be factored into dimensions of engagement with enhancing study strategies, test-taking attributes, and self-care practices. In terms of psychometrics, the ALTEN is reported to have good reliability and validity. Among other things, the ALTEN has presented a Cronbach's alpha of 0.84 for total ALT engagement and a Pearson r range of 0.76 to 0.93 (significant at p < 0.01) for the subscales as well as good item validity [29].

2.4 Procedures

The Ethics Review Committee of the Angeles University Foundation has approved the conduct of this study. The data gathering for the present research has been conducted in five (5) phases via online administration. Data collection for Phase 1 has been completed in A.Y. 2019-2020, while the students were attending their Applied Learning Theories (SSELECT) classes. Google Forms served as the primary means of disseminating the research instruments, and it was composed of three sections.

The first section of each Google Form contained the Informed Consent Form, which outlined the purposes of the study, the possible risks, and benefits, maintaining confidentiality, the procedures that participants will undergo in the study, and the voluntary nature of their participation as well as the contact information of the researchers. The respondents were encouraged to read the page contents. They were required to click on a button to signify that
they have read and understood the terms and conditions written in the Informed Consent Form and that they were voluntarily participating. Otherwise, they could withdraw by closing the Google Form without answering. They could also withdraw participation after answering the survey by contacting their professors and providing their ID numbers so the researchers can erase their data entries.

The second section of each Google Form included the demographic profiling section. As stated in the Informed Consent form, respondents were required to provide personal information, including their student ID number, complete name, gender, college, course/programme, type of school previously attended, and the previous school’s name. Such entries were used to identify the target population’s demographic profile and assist in the discussion and interpretation of all succeeding results of the study.

The last part of each Google Form was the survey proper. Participants answered research instruments with questions intending to measure psychological well-being, student engagement, and ALT engagement. A Google Sheet spreadsheet was generated per questionnaire, each containing the responses of the participants to serve as the comprehensive database of the current project. Prior to submitting their responses, participants were asked to recheck their answers and check if all given information was true and updated to the best of their knowledge.

3 Results and Discussion

The Google spreadsheet was generated, and the research instruments were scored according to the procedures stipulated for each scale. The data were then exported to IBM Statistical Package for the Social Sciences (SPSS) Statistics 22. Prior to the analyses, the data set was examined for missing items or data entry errors. Seven student responses were removed from the data set due to incomplete GWA resulting in a total of 1066 student responses for data analysis.

Means and standard deviations were computed for all study variables. The association between the total ALT instrument score and its three facets and GWA, USEI total score, and PERMA total score were analyzed using Pearson’s r; Coefficients of determination were also computed. Table 1 shows the results of the analyses. The total ALT engagement score was found to be positively associated with GWA, USEI, and PERMA. As for its facets, only ALT-SS and ALT-TTA were found to be associated with GWA. All three facets were positively related to USEI and PERMA. Scores from the ALT engagement instrument were found to have the strongest association with USEI and weakest with GWA.

Table 1. Means and standard deviations, and correlation coefficients of the ALT engagement instrument with GWA, USEI, and PERMA

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>GWA</th>
<th>r</th>
<th>r²</th>
<th>USEI</th>
<th>r</th>
<th>r²</th>
<th>PERMA</th>
<th>r</th>
<th>r²</th>
</tr>
</thead>
<tbody>
<tr>
<td>GWA</td>
<td>88.74</td>
<td>3.96</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USEI</td>
<td>58.47</td>
<td>6.845</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERMA</td>
<td>168.14</td>
<td>22.545</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALT-EN</td>
<td>107.81</td>
<td>12.107</td>
<td>.125**</td>
<td>.16*</td>
<td>.478**</td>
<td>.228</td>
<td>.350**</td>
<td>.122</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALT-SS</td>
<td>63.76</td>
<td>7.51</td>
<td>.155**</td>
<td>.024*</td>
<td>.448**</td>
<td>.201</td>
<td>.280**</td>
<td>.078</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALT-TTA</td>
<td>22.75</td>
<td>3.413</td>
<td>.106**</td>
<td>.011*</td>
<td>.459**</td>
<td>.211</td>
<td>.345**</td>
<td>.119</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The study's findings suggest that ALT as a course for freshman orientation and academic success is associated with students' academic achievement, well-being, and student engagement. As most freshmen success courses, ALT was designed to equip students with the knowledge, skills, and abilities necessary to transition to College and overcome their challenges in their first year of college [31]. Although there are a number of researches that looked into the contribution of freshmen success courses to students' observed growth and success, the findings are varied, from having positive results to no associations at all. A meta-analysis of the effectiveness of first-year seminars supports the current study's result in that first-year success courses have only a minimal positive effect on the first-year GPA [31]. Several relatively stable factors, such as cognitive ability and personality, have impacted academic achievement [25]. Consequently, ALT's short-term intervention as a freshman orientation and academic success course is not enough to account for academic achievement. It may be wise to consider long-term, continuous, and multi-faceted intervention programs to promote students' academic success [37].

Kahu and Nelson [21] provided a framework of student engagement that proposes that engagement is at the heart of an educational interface formed by the interplay between student characteristics and university practices. In the current study, ALT engagement is positively associated with student engagement. This association means while the students were engaged in ALT, there is an increase in the likelihood that they were engaged at the university level. Using Kahu and Nelson's framework [21], student engagement is facilitated by the interplay of the Institution and its students and the broader geopolitical context where the student is situated. It was emphasized that the University's role is to design curricula that are flexible to facilitate student and University interaction [24]. ALT was included in the different university programs' curricula to allow students to be more engaged in learning while developing their well-being. The inclusion of ALT is the University's response to deepening first-year students' engagement. Interestingly, student success courses have been known to enhance self-efficacy and confidence, and belonging, strengthening students' resolve to stay on their academic path, which is an indicator of engagement [23,28]. Factors such as self-efficacy, belonging, and well-being have been identified as mediating mechanisms that increase or decrease student engagement likelihood [21] but were not measured in the current research.

The current study also showed a significant positive association between ALT engagement and well-being. The relationship between constructs means that as students engaged in ALT, there is a corresponding increase in students' well-being. Student orientation courses that incorporated wellness were related to student wellness changes [14]. Since most first-year students go through transitional and developmental experiences, activating protective factors such as well-being is beneficial [39]. The results of the recent study conducted by Chatterjee & Jethwani [13] supported the claim of prior research that self-care is strongly linked with well-being - that the more a person practices self-care, the more that his or her well-being increases. Hence, it was intentional on the part of the designers of the ALT syllabus to include self-care practices that boost well-being. This strategy is beneficial in the long run as enhancing students' positive developmental assets may prove to be an excellent measure to enhance students' academic success in higher education [39].

The long-term consequences and the course's effectiveness have yet to be established in the project's succeeding phases. Although the results can help claim ALT as an example of good practice in the University's context, several limitations should be noted: Primarily, students'
GWA represents academic achievement, which is a limited representation of academic success. Other facets of academic success will be measured in the different stages of the research. Also, the current measure of engagement is limited only to the tri factorial structure of student engagement. However, mediating factors that influence student engagement were not explicitly measured in this study. Also, well-being in the study only represented total score and did not look into specific elements that make up well-being.

As the research continues, a system of evaluation of the in-class activities, readings, discussions, and topics of the course will be put in place to determine which is most effective. Specifically, there may be a need to recalibrate the topic of self-care practices to ensure that the learning goals and objectives are clearly articulated. Equally important is that as students’ progress through their degree program, it might be beneficial to integrate other educational success initiatives to reinforce what they learned in their first year at the University.

4 Conclusions

The University's decision to offer Applied Learning Theories as a General Education Elective was based on the impetus of leveraging data to develop targeted and focused intervention programs for students. Findings of the present study lend support to the premise that a subject that is anchored on research-based strategies and high impact educational practices will bridge the gap between college eligibility and college readiness. Results showed that as students learn and engage in the subject, they appear to become more academically and cognitively engaged. Easing from familiarity to eventual mastery of the topics facilitates collaboration with their teachers and classmates, hopefully leading to a greater sense of belongingness to the University. With the introduction of concepts such as the growth mindset, optimism, resilience, and mindfulness, among many others, students can develop positive emotions, sustain interest in challenging tasks, and inspire them to find their meaning and purpose. Providing these essential experiences to students may fortify their disposition to become academically successful.

References

[16] Fredricks J A, Filesecker M and Lawson M A 2016 Student engagement, context, and adjustment: addressing definitional, measurement, and methodological issues. Learning and Instruction, 43 pp. 1–4
[21] Kahu, E R, and Nelson K 2017 Student engagement in the educational interface: understanding the mechanisms of student success Student engagement in the educational interface Higher Education Research & Development 0(0) pp. 1–14
[39] Yu L, Daniel D T and Zhu X 2018 The influence of personal well-being on learning achievement in university students over time: mediating or moderating effects of internal and external university engagement Frontiers in Psychology 8(JAN) pp. 1–16
Faith and Wisdom Based Education

Susanto
{susanto280266@gmail.com}

Department of Biology Education, Faculty of Teacher Training and Education, Universitas Muhammadiyah Purwokerto

Abstract. Humans are aware that they are different from other species in terms of knowledge since they believe they are special and chosen beings. Humans are reflections of the ruh inside them, which has the ability to will and choose. According to Asy'arie, the aim of religion on Earth is to communicate God's sacred messages. The most essential factor, among others, is faith, which leads to grace, happiness, and release. In today's academic environment, scientific progress is bringing humanity closer to dehumanization symptoms, and possibly the potential of changing humanity's nature. As a result, education needs a foundation of intelligence and faith. If we are in confined areas, we will feel stressed and burdened. Descartes' statement cogito ergo sum (I think thus I exist, I exist thus I think) led to the establishment of Rationalism on Epistemology. As a result, the human mind, in general, is short-sighted and tends to think negatively, giving up before trying, losing before fighting, and fearing before something happens. The result of these typical human brains is that young people are less likely to attend college as a result of ineffective education and difficult job search after graduation. I get an agony, with the majority of them weeping for far too long because I regard it as a disaster, making it difficult to rise again. They are greedy if given the opportunity because they do not think Allah SWT would return to them. Haught and Peters use science and religious encounter to demonstrate the optimist character. The most important principle of all Islamic thinking, Tawheed, serves as the cornerstone for science and religious integration in education. As a result, humanity requires a faith-based and wisdom-based education. Indeed, as Allah's characteristic The Most Broad (al-Waasi'), Allah SWT has given humans fitrah to have a broad perspective. But that fitrah had already vanished. That fitrah has been covered by al-wahn illnesses (passion for the world and fear of death). We must resurrect. We must always project a good attitude, profound thought, vast knowledge, and wisdom.

Key Word: Faith, Wisdom Based Education, Symptoms of Dehumanization.

1 Introduction

If we are in a small place, we will feel pressured and burdened. However, if we were in open places, we would feel more free and light. Descartes' cogito ergo sum (I think thus I exist, I exist thus I think) led to the establishment of Rationalism on Epistemology [5]. As a result, most people are short-sighted and don't think optimistically, giving up before trying, losing before fighting, and fearing before something happens. These typical human thoughts are as follows: young people are hesitant to attend college because they believe it will be worthless and difficult to get work once they have finished. I am subjected to an agony, with the majority of them crying for far too long because I regard it as a disaster, making it difficult to recover. With scientific and religious interaction, Haught (2004) and Peters (2006) demonstrate the
optimist tendency [2,7]. The most important premise of all Islamic thinking, Tawheed [3], serves as the cornerstone for science and religious integration in education. As a result, humanity requires a faith-based and wisdom-based education. Indeed, as Allah's characteristic The Most Broad (al-Waasi'), Allah SWT has given humans fitrah to have a broad perspective. But that fitrah had already vanished. That fitrah has been covered by al-wahn illnesses (passion for the world and fear of death). We must resurrect. We must always project a good attitude, profound thought, vast knowledge, and wisdom.

2 Literature

Understanding a wide range of topics demonstrates deep thought and extensive understanding, and so cultivates wisdom. As Rasulullah SAW has previously proven as our role model, such things will improve our lives. He has previously given lessons on how to deal with various types of individuals. "Oh Rasulullah, what is the most prime deeds?" he questioned one of his associates, according to Bukhari. "Faith in Allah and His Rasul," he said. "What's next?" they inquired again, and he responded. "Fight in Allah's methods." They then inquired again, "And what's next?" he replied, "Mahrur Hajj." However, when given the same subject by other friends, he responded differently than previously.

3 Result and Discussion

The ruh, a particular gift from Allah SWT, has been given to people to glorify them. Humans have the power to engage with the invisible (metaphysical) reality because they have ruh (ability). In contrast to the world of animals. They can only perceive what's going on around them. Humans are able to see with this talent (Tasha our). Humans have broad and profound behaviors due to their thinking (fikrah) orientation (ittijah). Humans can differentiate between good and bad, right and wrong, halal and haram, if the aforesaid skills are founded on religion. This is referred to as furqon. Assume it isn't founded on faith. In that scenario, individuals would be drawn into a life of jahiliyyah (darkness).

Humans are aware that they are different from other species in terms of knowledge since they believe they are special and chosen beings. Humans are a reflection of the ruh inside them, which has the ability to choose and will [6]. According to Asy'arie (2006), religion on earth serves the vital function of communicating God's holy words; the most significant aspect is faith, which leads to grace, happiness, and emancipation [1]. In today's academic environment, scientific progress is bringing humanity closer to dehumanization symptoms, and even the potential of changing humanity's nature [9]. As a result, education needs a foundation of intelligence and faith.

Emil Brunner [8] states that a decent human being always does what God desires at any given time. As a result, when people are freed from their ruhani and separated from their Lord, they will become animals that dwell in confinement. It is important to take the following specific measures in order for humanity to return to the integrity of their soul, body, and wide wisdom, it is necessary to take the following concrete steps:

a. Humans must understand that they are merely a little portion of the cosmos (dots). Humans will never be able to comprehend the scope of His creation, His kindness, knowledge,
mercy, and forgiveness. Humans should not arrange themselves in their shells like frogs. Humans should continue to explore and learn.

**QS. Ar Rahman (55) : 33**

Meaning: "O company of jinn and mankind, if you are able to pass beyond the regions of the heavens and the earth, then pass. You will not pass except by authority."

b. Humans must understand that their existence in this planet has a purpose. Allah SWT, the Supreme Being, is the one who brings it. From conception until birth, the fetus develops into a newborn, toddler, teenager, adult, and senior citizen. Man must surrender to his Creator’s phenomena.

**QS. Al Baqarah (2) : 28**

Meaning: "How can you disbelieve in Allah when you were lifeless and He brought you to life; then He will cause you to die, then He will bring you [back] to life, and then to Him you will be returned?"

c. Humans must always study the nafsiyah (spiritual) passages that state that humans are made up of both physical and spiritual components. A reason for humans to live this life by meeting their bodily and spiritual requirements in a holistic and balanced way.

**QS. Shaad (38) : 71-72**

Meaning: "[So mention] when your Lord said to the angels, "Indeed, I am going to create a human being from clay. So when I have proportioned him and breathed into him of My [created] soul, then fall to him in prostration."

d. Because human raw materials are precious, their presence in this world is not just a joke but carries a noble life mission.

**QS. Al Mu’minun (23): 115-116**

Meaning: "And among His signs is that He has created for you mates, that you may find comfort in them just as He has created for you horses and cattle. You eat from the produce of their sweat and labor."
Meaning: “Then did you think that We created you uselessly and that to us you would not be returned?” So exalted is Allah, the Sovereign, the Truth; there is no deity except Him, Lord of the Noble Throne.”

QS. Adz-Dzaariyaat (51) : 56

Meaning: “And I did not create the jinn and mankind except to worship Me.”

Humans must heed Allah SWT's signs in order to be successful in wandering in the world (rihyatul hayah) and secure in the hereafter, because He is the one who provides life and knows its mysteries.

QS. Al Baqarah (2) : 38-39

Meaning: “We said, "Go down from it, all of you. And when guidance comes to you from Me, whoever follows My guidance - there will be no fear concerning them, nor will they grieve. And those who disbelieve and deny Our signs - those will be companions of the Fire; they will abide therein eternally.”

Humans must understand that the end outcome of this world's exam is either an award (pass) and entry into His paradise or a failure and entry into His damnation. How unjust is Allah SWT if there is no compensation? Humans who obey Allah SWT differ from those who disobey Him. A person's life will terminate in accordance with his or her worldly practices. Humans who used to sin would perish in su'ul Khaimah, whereas those who used to obey Him will perish in bustle Khaimah. As a result, humans must choose and choose their behaviors with care.

e. Humans must often look at their past lives as lessons and bridges to success in the future. Humans need to study history more carefully so that they do not fall into the same hole.
QS. Ali Imran (3): 137

قَدْ خَلَتْ مِنْ قَبِيلَكُمْ سُنُنُ فَسِبَّرُوا فِي الَّذِينَ فَانظُرُوا كَيْفَ كَانَ عَنْقِيَّةُ

Meaning: "Similar situations [as yours] have passed on before you, so proceed throughout the earth and observe how was the end of those who denied."

g. A human being’s mind’s breadth of understanding and perspectives is measured by his ability to successfully answer five fundamental questions: (1) Who is he, exactly? (2) How does one show himself to the rest of the world? (3) What is his purpose in life? (4) What should he do for the rest of his life? (5) Where will he go after living in this world? Humans will face a crisis of purpose in life if the five fundamental issues above cannot be addressed accurately and well in a way that satisfies the head and emotions (barrenness and shock of life in this world).

h. There are billions of planets and stars, each with its own unique features. There are huge areas, seas, woods, mountains, and other natural features on the planet where humans dwell. Minerals, water, oxygen, and carbon dioxide are among the components required for the life of living organisms such as plants, animals, and people in nature. The universe, according to modern scientists of all disciplines, is a source of intelligence (Russell intelligence). A sensation of wonder inspires astonishment at reality and the dazzling light that illuminates it, resulting in great works of science and art. Einstein himself claimed that a clash between science and religion is unthinkable [4].

4 Conclusion

Humans are also placed in diverse natural environments, resulting in variations in traditions, habits, and culture. Extensive in His Power and Knowledge, Extensive in His Mercy, and Extensive in His Forgiveness is Allah the Exalted.

QS. Al An'aam (6): 80

وَحَاجَةٌ، قَوْمُهُ قَالَ أَتْبَحَّتْجِوْيَنْ فِي اَللَّهِ وَقَدْ هَدِيْنْهَوْلاً أَخَافُ مَا تُشَفِّرُ كُونَ بِهِ، إِلَّا أنْ يَقْعَدَ رَبُّيُّ شَيْئًا وَيَسْعُ رَبُّيُّ كُلَّ شَيْءٍ عَلَمَهُ أَفَلَا تَنَبِّئُنَّ كُرُونَ
Meaning: “His people also disagreed with him.” he explained “Do you disagree with me about Allah when He has directed me? And I have no fear of whatever you connect with Him [and will not be hurt] until my Lord wills it. Will you forget that My Lord includes all things in knowledge?”

QS. An-Najm (53) : 32

Meaning: “Those who abstain from big crimes and immoralities, committing only minor ones.” Your Lord, indeed, is kind in his forgiveness. He knew the most about you when He created you from the ground and when you were fetuses in your mothers’ wombs. So don’t pretend to be pure; He is the most aware of those who fear Him.”

QS. Al Baquerah (2) : 115

Meaning: “And the east and the west belong to Allah. So the Face of Allah can be found everywhere you turn. Indeed, Allah is all-knowing and all-encompassing.”

QS. Ali Imran (3): 190

Meaning: “Indeed, indications for those who understand may be seen in the creation of the heavens and the earth, as well as the alternating of night and day”

QS. Adz Dzaariyaat (51): 20-21

Meaning: “And on the earth are signs for the certain [in faith] And in yourselves. Then will you not see?”
References


Age, Gender, Level, and Grade Effect on Foreign Language Learning Strategy

Saefurrohman
saefurrohman@ump.ac.id

Department of English Education, Faculty of Teacher Training and Education, Universitas Muhammadiyah Purwokerto

Abstract. This study aims to explore the relationship of age, gender, level and grade differences on students language learning strategy among Indonesian children who learn English as a foreign language. The participants were 350 students from junior high school in Banyumas, Indonesia The data collection tools were a background questionnaire consisting the variables mentioned and he Strategy Inventory for Language Learning, or SILL. After computing the reliability coefficient of the scale and total variance, Pearson correlation were used to see the relationships between language learning strategy and subject variables age, gender, level and grade. The result indicates that there is a relationship between gender and grade in English and language learning strategy in English. However, there is no relationship between age, level and language learning strategy in English.

Keywords: Age, Gender, Level, Grade, and Foreign Language Learning Strategy

1 Introduction

Good language learners are commonly considered to be those who can find their own way by taking care of their learning, organizing their language knowledge, and creating their own opportunities for language practice [1]. In addition, to support them in learning a language, they use their experience and strategy [2]. In addition, research involving language learners has also shown that the most active learners appear to use learning strategies that are relevant to the mission, content, self-objective, criteria, motivation and learning level [3][4][5]. It seemed that successful language learners had the potential to excel, while others lacked those skills.

For language learning, learning strategies are important because they are instruments for active, self-directed interaction [6]. Learning strategies should encourage the autonomy of learners in language learning and help learners promote their own accomplishments in language skills. Therefore, learning strategies assist learners to become successful in learning and using a language[7][8].

Learning strategies are the particular thoughts or actions that people use to help them understand, learn or maintain new data[9]. Oxford extends the concept of learning strategies and describes them as "the learner's specific actions to make learning simpler, faster, more enjoyable, more self-directed, more efficient, and more transferable to new situations" [10].

Concerning the effect of age, gender, level and grade on foreign language learning strategy, research suggests that age, gender, level and grade is a considerable predictor that relates to foreign language learning strategy [6][11]. However, some research also stated that age, gender,
level and grade is also a neglected variable regarding foreign language learning strategy while it is evident that adult and young learners cannot be treated equally in regards to their responses to foreign language learning strategy [12]. This study will therefore examine the correlation of age, gender, level and grade toward the students foreign language learning strategy.

2 Method

The goal of this study is to explore some factors influencing the students learning strategy in EFL class. In order to achieve the objective of the research, the quantitative data was adopted to collect descriptive and correlation data in order to explain the features of several groups of students. The students at Senior High School in Purwokerto City were the target respondents for this research. Therefore, the participants of this study were taken only from 9 Senior High schools of Purwokerto city, Indonesia with total 380 students. Oxford Strategy Inventory for Language Learning (SILL) was adopted to know the students language learning strategy [10]. Pearson Product moment correlation using SPSS statistic analysis was used to analyze the data.

3 Result and Discussion

3.1 Characteristic of Respondents (Age, Gender, Level and Grade)

The data are presented in tabular form for the following demographic characteristics: gender, age, level and grade in English. The result is as follow.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>135</td>
<td>35.5%</td>
</tr>
<tr>
<td>Female</td>
<td>245</td>
<td>64.5%</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13-14</td>
<td>31</td>
<td>8.2%</td>
</tr>
<tr>
<td>15-16</td>
<td>264</td>
<td>69.5%</td>
</tr>
<tr>
<td>17-19</td>
<td>85</td>
<td>22.4%</td>
</tr>
<tr>
<td>Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>157</td>
<td>41.3%</td>
</tr>
<tr>
<td>11</td>
<td>122</td>
<td>32.1%</td>
</tr>
<tr>
<td>12</td>
<td>101</td>
<td>26.6%</td>
</tr>
<tr>
<td>Grade in English</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>16</td>
<td>4.2%</td>
</tr>
<tr>
<td>70-79</td>
<td>80</td>
<td>21.1%</td>
</tr>
<tr>
<td>80-89</td>
<td>175</td>
<td>46.1%</td>
</tr>
<tr>
<td>90-100</td>
<td>109</td>
<td>28.7%</td>
</tr>
</tbody>
</table>

As shown in Table 1, the majority of respondents are female, consisting of 245 (64.5%) and only 135 respondents (35.5%) are male. Regarding age, 31 respondents (8.2%) were between 13 and 14 years old, 264 respondents (69.5%) were 14-15 years old and 85 respondents (22.4%) were between 15-16%. Among all respondents, 157 respondents (41.3%) indicated that they were in level 10, 122 respondents (32.1%) were in level 11 and 101 respondents (26.6%) were in level 12. Respondents were also asked about their grade in English, it was also then checked with the teachers’ document and the results were the majority of them had a grade
between 80-89 (175 respondents/46.1%), the second grades were between 90-100 with 109 respondents (28.7%), the next grades were between 70-79 with 80 respondents (21.1%) and only 16 respondents (4.2%) had a score between 60-69.

3.2 High School Students’ Language Learning Strategies

The students’ language learning strategies in English consist of fifty items divided into two main classes and six categories. The result of students language learning strategies can be seen at Table 2. Although the level of use by strategies category differs in one way or another, all means for the six strategies categories fell within the range of 2.5-3.4, which indicates that the respondents used each strategies category at medium frequency.

Table 2. Language learning strategies in English categories.

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Mean</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory (Remembering more effectively.)</td>
<td>3.24</td>
<td>Medium (sometimes used)</td>
</tr>
<tr>
<td>Cognitive (Using all your mental processes)</td>
<td>3.12</td>
<td>Medium (sometimes used)</td>
</tr>
<tr>
<td>Compensation (Compensating for missing knowledge.)</td>
<td>3.11</td>
<td>Medium (sometimes used)</td>
</tr>
<tr>
<td>Metacognitive (Organizing and evaluating your learning)</td>
<td>3.5</td>
<td>High (Usually used)</td>
</tr>
<tr>
<td>Affective (Managing your emotions)</td>
<td>3.3</td>
<td>Medium (sometimes used)</td>
</tr>
<tr>
<td>Social (Learning with others)</td>
<td>2.81</td>
<td>Medium (sometimes used)</td>
</tr>
</tbody>
</table>

When looking at the data results in the Table 3 and with respect to the chart dealing with how often the pupils employ the individual strategies, it can be stated that only metacognitive strategies were usually used by students. The others five groups of strategies are sometimes employed by the students.

3.3 Gender and Students’ Language Learning Strategies in English

Table 3 shows the Pearson product moment correlation result between gender and students’ language learning strategies in English. As can be seen the result is 0.107 and $r$ table value at df (379) and sig. level (0.05) is 0.037, thus $r$ result is higher than $r$ table (0.107 > 0.037) and it is indicated that there is a relationship between gender and language learning strategies in English.

This finding means that the strategies used by the students are influenced by their gender. In other words gender affected to the strategies use in which some researches also revealed that female subjects engaged in strategies use more frequently than male subjects.

Table 3. Correlation results for gender and language learning strategies in English.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Learning Strategies</th>
<th>Pearson Correlation</th>
<th>Sig. (2-tailed)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>380</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning Strategies</td>
<td>Pearson Correlation</td>
<td>0.107*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>380</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 3.4 Age and Students’ Language Learning Strategies in English

Table 4 shows the Pearson product moment correlation result between age and students’ language learning strategies in English. As can be seen, the result is \( r = -0.02 \) and the table value at df (379) and sig. level (0.05) is 0.973, thus the result is lower than the table (-0.02 < 0.972) and it is indicated that there is no relationship between age and language learning strategies in English.

This finding means that a different age of students will have no different in their learning strategies or age does not affect the students’ learning strategies because older students employ the same strategies with the younger one.

<table>
<thead>
<tr>
<th>Learning Strategies</th>
<th>Pearson Correlation</th>
<th>Sig. (2-tailed)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>(-0.02)</td>
<td>0.973</td>
<td>380</td>
</tr>
</tbody>
</table>

### 3.5 Level and Students’ Language Learning Strategies in English

Table 5 shows the Pearson product moment correlation result between level and students’ language learning strategies in English. As can be seen, the result is \( r = 0.055 \) and the table value at df (379) and sig. level (0.05) is 0.287, thus the result is lower than the table (0.055 < 0.287) and it is indicated that there is no relationship between level and language learning strategies in English, meaning to say that level of education do not affected to the use of language learning strategies.

<table>
<thead>
<tr>
<th>Learning Strategies</th>
<th>Pearson Correlation</th>
<th>Sig. (2-tailed)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>0.055</td>
<td>0.287</td>
<td>380</td>
</tr>
</tbody>
</table>

### 3.6 Grade and Students’ Language Learning Strategies in English

Table 6 shows the Pearson product moment correlation result between grade in English and students’ language learning strategies in English. As can be seen, the result is \( r = 0.162 \) and the table value at df (379) and sig. level (0.05) is 0.02, thus the result is higher than the table (0.162 > 0.02) and it is indicated that there is a relationship between grade in English and language learning strategies in English.
This finding means that the learning strategies used by students are influenced by their grade. On the other words, different achievement in English affected the language learning strategies use. Usually, clever students use better strategies in learning English than the lower one.

Table 6. Correlation results for grade in English and language learning strategies in English

<table>
<thead>
<tr>
<th>Learning Strategies</th>
<th>Grade in English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>.162**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.002</td>
</tr>
<tr>
<td>N</td>
<td>380</td>
</tr>
</tbody>
</table>

4 Conclusion

On answering the question “Are there any significant relationships between the students’ language learning strategy and their profile (gender, age, level and grade in English)?”, the result indicates that there is a relationship between gender, grade in English and language learning strategy in English. However, there is a no relationship between age, level and language learning strategy in English.

References

Implicature of Identity Reinforcement in The Speak of Emha Ainun Nadjib (Cak Nun) on Video Youtube

Eko Suroso¹, Sumarlam², M. Rohmadi³, Sumarwati⁴
{ekosuroso36@gmail.com}
Universitas Muhammadiyah Purwokerto¹, University of Sebelas Maret Surakarta¹,²,³,⁴
Central Java, Indonesia

Abstract. When the researcher listened to MH Ainun Nadjib's (Cak Nun) speech on social media (medsos) YouTube, the researcher found a phenomenon that many of Cak Nun's utterances contained identity-strengthening implicature. The problems that arise are 1) what are the forms of implicature in Cak Nun's speech on YouTube, 2) what are the forms of strengthening the identity contained in Cak Nun's speech on YouTube. Implicature is something that is left implicit in the actual use of language. Self esteem is a condition or special characteristic of a person that causes a person to be strong in his opinion. This research was conducted with a qualitative descriptive approach. The data of this research are Cak Nun's utterances on Youtube. The data source is Youtube social media. Data analysis was performed using content analysis techniques. The results of this study conclude that there are two forms of implicature in Cak Nun's speech, namely conversational implicature and conventional implicature. In addition, in this study it was also found that there were twelve characters used by Cak Nun to strengthen a person's identity, namely social care, creative, disciplined, love for the country, religious, honest, independent, peace-loving, hard work, tolerance, democracy, and the spirit of nationality.

Keywords: Implicature, Identity, Cak Nun Speech

1 Introduction

When the researcher listened to Cak Nun's speech on the YouTube social media, the researcher found Cak Nun's speech as follows:

I don't want to be chased after America, the United States really wants me to. Apane sing nicely at Amaerika school, dhekne powder to Bali karo Indonesia we ora iso. What's great singe?. I don't want to go after America, because America is behind me. What's good about America is that he differentiates Bali from Indonesia, he is not biased. What's so great?.

In fact, Cak Nun's utterance contains identity-strengthening implicatures. Today, many Indonesians exalt America too much. It is as if America is more powerful and modern than Indonesia. Many Indonesians are more proud of being said to be people who act as Indonesians. Cak Nun's speech implies that we as Indonesians don't need to feel inferior to the Americans or any other nation in the world because our life goals are different.

On different occasions, the researcher also received Cak Nun's speech which had implications for strengthening identity. The complete speech is as follows:
No language is as rich as Indonesian, Father...a Javanese, Sundanese too, Madurese too. I'll be angry if I don't mention Madura. Java is Masya Allah ... Masya Allah ....grandmother ngene...jungkel ... grandma ngene ... jlungup, grandma ngene..nggeblak ... wong English kuwi ora understand bedane ambune uyuh, ambune kelek, ambune tai. Ngono, how come?.

Most Indonesians are very proud of English, even though English is actually very poor in vocabulary. Therefore, Cak Nun's speech implies strengthening character so that Indonesians - especially Javanese - are proud to use their Javanese language. Sundanese and Madurese people are proud of their Sundanese and Madurese languages. Our local language is part of who we are. Therefore, we need to learn Javanese, Sundanese, Madurese and other languages and we need to uri-uri so that they don't die.

From the two quotations from Cak Nun's speech, it implies that there is a possibility that there are still many Cak Nun utterances that contain identity-strengthening implications. However, it is still a possibility. To find out whether this possibility is true or not, an empirical study is necessary. Therefore, the research entitled Implicatur Strengthening the Identity in Mh. Ainun Nadzib (Cak Nun) on Youtube 2019 is very important to implement. The objectives of this research are 1) to describe the implicit forms contained in Cak Nun's speech on youtube 2019, 2) to describe the forms of strengthening the identity contained in Cak Nun's speech on youtube 2019.

Implicature is something that is implied in a conversation: something that is left implicit in the actual use of language [8]. Implicature is a process of interpreting meaning based on situations and contexts [11]. By using implicature theory, we will be able to understand the meaning implied in the speaker's speech. In a conversation there is always a meaning that is not explicit [14]. Someone asked, Bud, do you have IDR 50,000? This sentence is not just asking whether Budi (the communicant) has Rp. 50,000 or not, but there is a hidden meaning, one of which means that the speaker will borrow Rp. 50,000. Therefore, the communicant (interlocutor) does not need to answer that there is nothing but silence, but there is, what do you need? In a communication, the second answer (yes, what do you need?) Is more successful than the first answer (there is continued silence). The success in question is preferred by the communicator because the communicator does not need to make a detailed explanation of his intention to borrow money.

This is also said by Gazdar [5], implied as a proposition implied by the utterance of a sentence in a context, even though the proposition is not a part or entailment of what is actually being said (implied proposition is the implied proposition of a sentence in a context, even though the proposition it is not part of the entailment). The proposition in this case is how something is aimed and how to state it [21]. In other words it can be said that propositions are speech. If it is said that the implicature is the implied proposition of the utterance of the sentence, it can be interpreted that the implicature is the implied utterance of the speech (sentence). Paul Grice [6] in his article entitled Logic and Conversation cites Brown and Yule [2] as saying that implied terms are used in narrative events. A speaker may describe something that is interpreted, implied, or afraid that is different from what is being spoken. Grice is quoted by Phillips, T. C. [18] as saying that the sentence implicature is a proposition or implicit statement, that is, something that may be interpreted, implied, or edited by the speaker, which is different from what he says. What happens is the pragmatic implication that occurs in the time that occurs as one of the causes of the principles [22].

In speech, speakers and speech partners who are appropriate to obey the principles of principles, however, participants in the speech, whether intentionally or not, may violate these principles. Therefore, the term Implicature appears which is pragmatic implication resulting
from the Grice Cooperation Principle [6]. Violation of the principle of cooperation causes implicature [2]. The implicature of a sentence is a process of interpreting meaning based on situations and contexts. By using conversational implicature theory, we can understand the meaning implied in a speaker’s speech. From the description above it can be stated that a word, a word, a speech that is implied, or interpreted by means of a word.

Identity is a very important part of human character. Without identity, someone will easily be swayed by situations and or circumstances. Socrates in around the 5th century BC (BC) taught his people with a statement to know yourself [7]. Likewise in the puppet story, when Werkudoro will receive Tirta Kamandaru from Dewa Ruci, Dewa Ruci has started his advice with the phrase, You must understand who you really are. Because of the importance of identity, this has been mandated by Law No. 24 of 2009 concerning the Flag, Language and National Symbol and the National Anthem, CHAPTER III Article 25 paragraph 2 which states that the Indonesian language functions as the national identity.

The form of identity is a form of behavior that needs to be developed so that a person has a strong and resilient identity. The form of behavior globally is like the precepts in Pancasila. The form of specific and operational behavior is as existing in the 18 national characters. Thus, the forms of identity that will be used in this study are 18 national characters. This is in accordance with what is mandated by Law no. 20 of 2003 concerning the National Education System.

In article 3 CHAPTER II it is stated that national education functions to develop capabilities and shape the character and civilization of a nation with dignity in order to educate the nation's life, aiming at developing the potential of students to become Marusia who believe and fear God Almighty, noble, healthy, knowledgeable, competent, creative, independent, and a democratic and responsible citizen. In that article, it is stated that national education has the function of developing capabilities and shaping the character and civilization of a nation with dignity in the context of developing the intellectual life of the nation. In order to shape the character and civilization of a nation with dignity, an identity is needed. Without identity, a person's character will become unstable and easily swayed by circumstances. How important this identity is, this is also mandated by Law No. 24 of 2009 CHAPTER III article 25 paragraph 2 which states that the Indonesian language functions as a national identity. Therefore, the 18 national characters are concrete forms of behavior that need to be developed in order to form identity. Thus, the form of identity referred to in this study are eighteen concrete forms of that behavior.


2 Method

This research was conducted with a qualitative descriptive approach. In carrying out a descriptive approach, the researcher describes, describes, and presents data in the form of the implications of strengthening the identity contained in Cak Nun's speech on Youtube 2019. In a qualitative approach, the researcher makes interpretations of the research data to determine the forms and forms of implications. -the form of Cak Nun's speech which contains strengthening of identity. The data of this research are Cak Nun's speech on Youtube 2019. Cak Nun's speech in that case is described and explained to be grouped into implied forms and forms
of identity strengthening. From the various forms of implicature contained in Cak Nun's utterance, it is elaborated again to find out the implications of strengthening his identity. The data source for this research is the 2019 Youtube video.

Data in the form of Cak Nun utterances were taken using the listening technique. In that case, the researcher listened to Cak Nun's speech which was contained in the 2019 uploaded youtube video. The results of the hearing on Cak Nun's speech were transcribed in writing and then entered in the data card. The Cak Nun speech contained on the data card will be used as study material (data) to be analyzed. The data in the form of a transcription of Cak Nun's speech that is already contained in the data card are analyzed one by one to find out the forms of implicature and forms of strengthening his identity. As already stated in the theoretical basis that there are three forms of implicature, the results of the implicature analysis of Cak Nun's speech are grouped into three implicature forms. Of the three forms of implicature, the researcher analyzed again to find out which of these implicatures contained the strengthening of identity. The final step is to classify the various forms of identity implicatures according to the 18 types of national characters.

3 Results And Discussion

3.1 Implications of Strengthening the Character of Social Care in Emha Ainun Nadjib's (Cak Nun) Speech on Youtube 2019

Social care attitudes and actions that always want to give help to others and society in need. So far, there are different opinions in the community regarding the disaster of opening a shop (restaurant) in the month of Romadhon. This attitude first states that it is better if food stalls are closed during the month of Romadhon because it is to respect people who are fasting. The second position states that the food stall remains open because not everyone fasts during the month of Romadhon.

Cak Nun's speech during the Islamic Cultural Performance that took place at UGM showed that food stalls in the month of Romadhon should remain open because not everyone is fasting. The complete speech is as follows:

… I asked the intellectuals, if there is a shop open in Romadhon, what is your attitude? Siji, your rumors are kabeh wong poso po (one, do you think everyone is fasting?), Now your wife is menstruating, your brother is a brother, your father is on the road, your father works as a coolie, abot tenan (really heavy) .. jur ora ono warung ( then there are no food stalls open), jur arep ngrikiti drijine dhwewe po (what will eat his own fingers?)…. (Data 01)

Based on the conversational implications in Cak Nun's speech, it appears that in fact Cak Nun does not agree that all food stalls must be closed in the month of Romadhon because there are people who are traveling who in that case really need food stalls. This implication of Cak Nun's speech shows that Cak Nun is very socially aware because what is said is not solely for his own comfort but also for the convenience of others, namely menstruating women, a coolie (hard worker), and people who are deep all of which really require food stalls to remain open even in the month of Romadhon.

3.2 Implications of Strengthening Creative Character in Emha Ainun Nadjib's Speech on Youtube 2019
Creative character is a thinking and/or action behavior to produce something new. This creative attitude is shown by Cak Nun's speech as follows:

… We cooperate with Allah. Allah made wood, our trees made poles ... that's how it is. Allah makes mathematical calculations, we build computers. … (Data 02)

The creative character in Cak Nun's speech (Data 02) is shown by the words Allah makes wood, tree ... we make poles and Allah makes mathematical calculations, we build computers. The word make in oral communication means to make. Someone can make something from certain basic materials means someone has been declared creative. From Cak Nun's speech on data 02, it means that it contains the implication that we must have a creative attitude. What Cak Nun wants to develop in the data 02 speech is a creative character because there is a way to make something into a new form.

3.3 Implications of Strengthening Discipline Character in Emha Ainun Nadjib's Speech on Youtube 2019

Character strengthening shown by Cak Nun in his speech at the Islamic Cultural Performance at UGM. The speech in question is as follows:

… So Mathematics and Natural Sciences people who study the attributes of Allah, Faculty of Biology, Geodesy, Pharmacy, Social and Political Sciences, Faculty of Cultural Sciences… all as long as they base themselves on the awareness of learning and developing that is served by Allah means UGM is paid whatever is acceptable from Allah SWT…. (Data 03)

In the speech data 03, Cak Nun implicitly wants to state that the obligation of students to their campus is to pay tuition fees. So that students do not feel burdened by tuition fees and feel light by paying anything, Cak Nun said that ...all people from basing themselves on awareness and developing that are served by Allah means that studying at UGM pays whatever can be rewarded by Allah SWT …. Caknun's speech seemed to make students aware of their obligation to pay. If someone has been sincere in carrying out an obligation that will automatically be disciplined, because one of the reasons someone is not disciplined is because that person is not sincere.

3.4 Implications of Strengthening the Character of Love for the Homeland in Emha Ainun Nadjib's Speech on Youtube 2019

The character of patriotism is a way of thinking, behaving, and acting that shows loyalty, concern, and high respect for the nation's language, physical, social, cultural, economic and political environment. This character is reflected in Cak Nun's speech as follows

--- I do not want to pursue America, because America is behind me. What's good about America, she is not biased in distinguishing Bali from Indonesia. What's so great? --- (Data 04)

Almost everyone deeply values America. As if America is the perfect country. A person will feel proud if he has ever been to America, let alone be able to work or get education there. Almost all American products are the pride of the world. However, Cak Nun's Speech as shown in data 04 shows that America is in fact no better in all respects than Indonesia. We cannot compare the elephant to which ant is bigger. The size of an elephant is like that and the size of an ant is only that big. If you want to compare, it's not an elephant with an ant, but an elephant with another. Nor can we compare which one is happier a farmer or a minister. It could be that a farmer is happier than a minister. Therefore, we also do not need to compare which one is better or more advanced between America and Indonesia because in certain matters Indonesia can be better than America. We don't need to use other people's standards to determine our
progress or not. This kind of speech by Cak Nun greatly strengthens the character of love for the country.

3.5 Implications Implications of Strengthening Religious Character in Emha Ainun Nadjib's Speech on Youtube 2019

The strengthening of religious character was also seen in Cak Nun's speech in the event “Kenduri Cinta”. At that event Cak Nun said the following:

If a judge decides...thok...that and it is not Allah in his mind file, that means an atheist hammering. (Data 06)

In data 06, it appears that Cak Nun's utterance in this case can strengthen religious character. What is meant by religious character in this case is the attitude and behavior that is obedient in carrying out the teachings of the religion he adheres to, and this is the main attitude a person must have in order to have a strong identity. In the teachings of Islam, a person must always remember Allah, whether they are free or busy, and in a difficult or happy state. From Cak Nun's speech in data 06, Cak Nun gave an example that if a judge decides... thanks... that's and not Allah in his mind file, that means an atheist hammer beat. From the narrative of data 06 it is clear that if, in doing and/or deciding something, a person does not present Allah in his thought process, it can be said to be an atheist conclusion. The implication of this speech is that we always present Allah in every breath we breathe, both in thinking and in action. This implicature greatly strengthens the religious character.

3.6 Implications of Strengthening Honest Character in Emha Ainun Nadjib's Speech on Youtube 2019

Strengthening honest character is an effort either through words or actions so that someone can act honestly. Honest is behavior that is based on the conformity between what is in his heart and mind with his words and behavior both alone and with other people. Caknun at the Kenduri Cinta event said the following.

... You are here Honestly .. God willing, it means that you are compatible with Allah... placing him on you... (Data 07)

The implication of Cak Nun's speech is that it is important for us to be honest because honesty shows that we are what the Creator wants us to do. Based on Cak Nun's speech, implicitly there is a place where we can be honest, and there is a place where we cannot be honest. It can be seen in the speech ... You are here Honestly .. God willing.... Another implication of Cak Nun's speech (data 07) is the importance of us always being compatible (adjusting) and always putting (thinking) about Allah so that we can always be honest. Honest character is impossible for us to get if we are not compatible and are always lodging with God.

3.7 Implications of Strengthening Independent Character in the Speech of Emha Ainun Nadjib (Cak Nun) on Youtube 2019

Cak Nun's utterances on various Youtube circulating in 2018 also strengthen the character of Mandiri. One of the speeches is as follows.

I don't want to be chased after America, the United States really wants me to. Apane sing nicely at Amaerika school, dhekne powder to Bali karo Indonesia we ora iso. What's great singe? I don't want to go after America, because America is behind me. What is good about America is that he differentiates Bali from Indonesia alone. What's so great? . (Data 10)
Almost all people on this earth recognize that America is a very developed country. Almost all countries in the world are competing to become developed countries like America. The concept of being advanced for most people and also for the country is material history, for example: mastering technology, magnificent buildings, luxurious vehicles, and abundant assets. Meanwhile, the advanced concept according to Cak Nun is different, namely someone who is strong in personality so that he is not easily influenced by others. The essence of the needs of human life is not material fulfillment but the fulfillment of spirituality as a provision in the hereafter. Therefore, because of the different concept of advanced problems, Cak Nun's speech in data 10 stated that he did not want to pursue Amarika because America was far behind him.

3.8 Implications of Strengthening the Character of Love and Peace in the Speech of Emha Ainun Nadjib (Cak Nun) on Youtube 2019

The character of Peaceful Love is the attitude, words, and actions that cause other people to feel happy and secure in their presence. Cak Nun's speech, which implicitly contains the character of peace-loving, is presented in data (11) as follows.

…In Islam it is a matter of love. So why do people follow Muhammad. Why do people adhere to the Alqurun. It's a matter of love ... In Islamic knowledge, first there is fiqh, above which there is law, on top of that there are morals ... and the highest is Love. (Data 11)

From Cak Nun's speech, it contains implications for the strengthening of the Love of Peace character. Peace can be obtained if someone has love for one another. The highest peak of piety is love for the Creator. If all love is based, the duties and obligations that must be done by someone will feel very light and always excited.

3.10 Implications of Strengthening the Character of Hard Work in Emha Ainun Nadjib's (Cak Nun) Speech on Youtube 2019

Hard work is a character that every human being must have. This hard work attitude was conveyed by Cak Nun at the Maiahan event in Yogyakarta. The complete speech is as follows.

---I am this, my dear friends, I just remembered that I have had forums like this for 42 years. I started in seventy-two years and I remember that the first time was in the village, in Jogya, behind Jalan Mangkubumi, there is a riverbank called the Jogoyudan village. There I met the people for the first time and it was done continuously, until the number myself was tens of thousands, if at Kiai Ageng, three thousand and eight hundred and what I am grateful for is not the record. What I am grateful for is that I have never asked for anything. Alhamdulillah, I did not wish for anything I never demanded anything. I never keep dreaming because I always know I will become this, no, I didn't ask. I didn't ask for anything from this so-called Indonesia from the public, didn't ask. I never make transactions, I never, I just enjoy,--- (Data 12)

In data 12, it is stated that it has been twelve years since Cak Nun and Kyai Kanjeng have appeared in forums both locally, nationally and internationally. This cause is an achievement in itself if it is experienced by certain groups. However, what makes Cak Nun proud is not his achievements but his inner strength to not accept anything from the 42 years of activities. The dream of Cak Nun's speech is the important thing is hard work. At work, you shouldn't have to be too calculated on the results because the results themselves will later adjust to our hard work. Many people are willing to work hard but by calculating how much they will get. This is not
wrong, but it cannot be categorized as hard work by Cak Nun as said … Alhamdulillah, I do not expect anything, I never demanded anything ...

3.11 Implications of Strengthening the Character of Tolerance in Emha Ainun Nadjib's (Cak Nun) Speech on Youtube 2019

Tolerance has often been misunderstood. To tolerate means to follow what people who are different from us want. Such a definition is very imprecise. In Cak Nun's speech at the Maiah event, it is said as follows.

Tolerance is even though you don't agree and you blame you, you still get along well with each other as humans. Tolerance is needed because of differences because if it is the same, there is no need for tolerance. (Data 13)

Data 13 implies that there is a character of tolerance that Cak Nun's speech wants to strengthen. As we all know that every human being is different from one another. That is where respect and / or respect for differences with each other is needed because… Tolerance is needed because of differences because if it is the same, there is no need for tolerance… the concept of tolerance and the importance of tolerance that Cak Nun wants to strengthen is very clear, namely to overcome differences from one another.

3.12 Implications of Strengthening the Character of Democracy in the Speech of Emha Ainun Nadjib (Cak Nun) on Youtube 2019

Democratic character is a way of thinking, behaving, and acting that values the rights and obligations of oneself and others. Some of Cak Nun's words on Youtube also strengthen the character of democracy. However, the democracy as stated by Cak Nun in this regard is a meaning from a different point of view. Democracy in Cak Nun's speech is interpreted as in the majority's word. The complete speech is as follows.

Democracy is the dictator of the majority. Pokoke sing bolone sing won ... lak ngono a. ... yo wis muk ngono thok ... dadi moring-moring grandmother is the majority dictator ... Ancene is the majority dictator ...

The meaning of democracy itself is actually very good, namely treating others to have the same rights and obligations as ourselves. The hope is that we don't look down on other people. However, if the word democracy is used as a way to elect a leader, what will happen is as said by Cak Nun ... Pokoke sing bolone sing wins…. This indicates that a leader does not have to be good and true, but the important thing is to have a lot of friends or supporters. The implication of Cak Nun's speech about democracy is that we no longer elect a leader based on the number of friends or supporters, but because the leader's character is good.

3.13 Implications of Strengthening the Character of the National Spirit in the Speech of Emha Ainun Nadjib (Cak Nun) on Youtube 2019

The character of the national spirit contained in Cak Nun's speech is the spirit of repairing and loving Indonesia because the implication of Cak Nun's speech in the event at UII, Indonesia was wrong from the start because it did not follow the lineage of his ancestors. This can be seen in Cak Nun's speech as follows.

We used to be colonized after that to become Indonesia… that's not what we want. Then we separated from Brunai. We become a different country from Malaysia even though we are the same as them, the culture… everything. Suddenly we become strangers who are not of our own nationality and it's all not because we want to but because we were colonized by English folklore, etc. So in fact, Indonesia is a child of
The implication of Cak Nun's speech is that Indonesia originally did not exist because there were kingdoms in a certain area which later part of the area were colonized by the Dutch… Jane ora ono Indonesia… asline. However, because Indonesia already exists, however we must love it and we make it up (fix it). In the speech of Cak Nun, improvement is impossible for generations of Cak Nun's age to make improvements by the new generation that is loved by Allah (could be the millennial generation).

4 Conclusion

The implication of strengthening identity in Cak Nun's speech on YouTube 2019 social media can be concluded that there are twelve forms of character strengthening. The first character strengthening implicature is Social Care. The second character strengthening implicature is creative. The third character strengthening implicature is Discipline. The fourth character strengthening implicature is Love of the Motherland. The fifth character strengthening implicature is religious. The sixth Character Strengthening Implicature is Honest. The seventh character strengthening implicature is Independent. The eighth character strengthening implicature is Love of Peace. The ninth character strengthening implicature is hard work. The tenth Character Strengthening Implicature is Tolerance. The eleventh character strengthening implicature is democracy. The twelfth character strengthening implicature is the National Spirit.

The strategy of strengthening character using implied forms is very effective. This can be seen from the number of congregants who follow and pay attention to Cak Nun's various speeches in various forums. Many of the congregants also attended Cak Nun's oration from night to morning. Cak Nun's speech in strengthening various community characters is very creative. The third character strengthening implicature is Discipline. The fourth character strengthening implicature is Independent.

The strategy of strengthening character using implied forms is very effective. This can be seen from the number of congregants who follow and pay attention to Cak Nun's various speeches in various forums. Many of the congregants also attended Cak Nun's oration from night to morning. Cak Nun's speech in strengthening various community characters is very effective.

Reference

The Role of Class Teachers in The Implementation of Guidance and Counseling in The Formation of Characters in Children with Special Needs

Lia Mareza
{liamareza@ump.ac.id}
Universitas Muhammadiyah Purwokerto, Purwokerto, Indonesia

Abstract. This research was conducted at SDLB B Kranji. This study aims to determine classroom teachers' role in implementing counseling guidance services in character building for students with special needs at SDLB B Kranji. Research to be conducted by researchers using qualitative research. The data validity used triangulation. Data collection techniques using observation, interviews, and documents. Triangulation testing used by researchers is a triangulation of sources and triangulation of methods. The results showed that teachers at SDLB B Kranji did their role well, namely classroom teachers, to implement counseling guidance services and foster self-confidence, discipline, and achievement motivation to have good character. Implementation of counseling services using individual and classical guidance. Service users' forms are support and responsiveness services, personal counseling services, and group guidance services. The result is that teachers provide counseling guidance services through the provision of rewards, habituation, and punishment if necessary to instill good habits so that students with special needs can behave and act based on the values that have become their personalities.

Keywords: counseling, character education, children with special needs.

1 Introduction

Education is an essential thing for every individual because education provides knowledge and teaches how to behave appropriately. Education fosters students into mature individuals, individuals who can design the future and make the right decisions in life to develop their potential to become better at achieving predetermined goals. Character education is a form of human activity in which there is an educational action intended for the next generation. The teacher's character building is significant for elementary school students, especially students with special needs. One of the critical stages that must be considered is primary education, which becomes a solid foundation for development at the next step and the formation of understanding, attitudes, and lifelong learning behavior (long life learning). [1] states that building the Nation's character through education must be followed up with a continuous and systematic program. They are starting from cognitive value recognition, affective value appreciation to real value practice. [2] revealed that character education is a conscious effort made by teachers to students who teach and shape good morals, ethics, attitudes, motivation, behavior, skills, and a sense of culture and noble character so that it fosters student abilities to give good and bad decisions and
to bring goodness into everyday life. Implementing character education in regular schools is not much different from implementing inclusive schools or special schools. The difference lies in students with special needs in the class and the way teachers instill character values in all students with special needs.

[3] explains that character development has a particular purpose for an education system. According to [4], character planting can erode the negative attitudes that a person often carries out. Through education, knowledge is achieved, but skills and attitude become a goal and assessment. In this case, it can also be social skills in children with special needs. [5] argues that adults’ guidance is carried out to children to provide teaching, moral improvement, and academic training. Developing the potential for students with special needs through the teacher's affective learning process, one of which is to form character in students. [6] explains that name is the typical good values (knowing the importance of kindness, wanting to do good, having a perfect life, and having a good impact on the environment) embedded in oneself and manifest in behavior.

Characters formed, such as self-confidence, discipline, and achievement motivation will develop student learning achievement. In the initial interview with the school, the basic things that become the basis for developing student achievement with special needs start from building self-confidence and the desire to be disciplined and motivated to achieve. The learning process requires an explanation that will encourage individuals to do work. [7] states that learning includes habits, skills, attitudes, understanding, interests, appreciation, and self-adjustment. The teacher has a role in growing and motivating students. [8] stated that motivation is defined as students’ tendency to carry out learning activities encouraged by the desire to achieve good achievement and learning outcomes. Cultivating good character will foster achievement motivation in students as well. [9] stated that achievement motivation is the desire to experience success and participate in activities; success depends on one's efforts and abilities. An individual who has learning motivation can be seen when learning takes place, including students paying attention to the teacher who is explaining the learning material, students want to do assignments, and students want to do homework given by the teacher and carry out student assignments or obligations in a disciplined manner. School rules and operational support programs in schools are also proven to be able to improve discipline both in school attendance, how to dress, how to behave, a sense of responsibility for their obligations, study diligently illustrates good characteristics of students and reduces harmful activities such as tantrums, insecurity, or not concentrating. [10] explains that school discipline supports the creation of student disciplinary attitudes because they contain requirements that must be implemented by students and prohibitions that must not be implemented. [11] explains that the role of classroom teachers is also a counseling teacher in elementary schools, namely that teachers must be able to understand the characteristics and abilities of each student, help students solve problems, teach the ability to behave and have social relations, help students develop discipline learning to increase the learning achievement of students with special needs.

Achievements in learning that are owned can be built through the student's self-confidence. [12] explains that self-confidence is part of one's cognition that influences one's decision-making to organize and organize actions to achieve the results someone wants. This personality aspect is in the form of a person's high self-confidence and abilities. [13] said that someone who has self-confidence would neutralize the tension that occurs in him to face the problems he is experiencing. When children with special needs can regulate negative emotions so that students can focus on their learning, according to [14], it explains that if an individual has high confidence, he will get an assessment of his / her abilities and the individual's process can feel merit to succeed. [15] argues that students’ self-confidence will affect the results, namely
learning achievement in both academic and non-academic fields. This is because it is not only in the knowledge aspect but also in the non-academic aspects of students with special needs who can excel in one particular field. [14] explains that good student self-confidence will affect academic and non-academic quality with teachers' role in learning and parents. This involves students to feel proud of themselves so that it triggers to increase their self-confidence and develop themselves based on self-confidence.

Based on interviews with the Principal of SDLB B Kranji, the character planting program in students has been implemented well. The teacher does this by providing guidance and counseling services to students that are carried out classically when learning occurs and individually between students and teachers; even the principal also participates in the guidance and counseling. Teachers' role in providing advice and counseling services can offer enormous changes to students with special needs so that students' character is well-formed with the embedded value of character education.

2 Methods

The research method used in this research is descriptive qualitative because it aims to describe teachers' role in the implementation of guidance and counseling services in character building for students with special needs. The goal is to find out the part of teachers in the performance of guidance and counseling services in character building for special needs students. The research subject is any participant who can provide information related to the research objectives. The matter's role is to give responses and data about the researcher's data and give input to the researcher, either directly or indirectly. Researchers chose research subjects, namely class teachers and students with high-class special needs. There are 1 class teacher, the principal, and eight students with special needs. Data collection was collected using observation, document recording, and interviews. Documents used include teacher books, student books. The interview method was carried out by extracting information from sources (class teachers, school principals, students) about guidance and counseling services in character building.

3 Results

Counseling guidance in elementary schools is essential for a classroom teacher. Services in guidance and counseling will run smoothly if a teacher understands students' characteristics to achieve the desired goals. Guidance is provided to all students so that there is no jealousy between students with special needs. The teacher approaches students to find the source of the problem so that it can be overcome.

3.1 The Role of Class Teachers in the Implementation of Guidance and Counseling in Building Confidence Character

Not all students with special needs have self-confidence, even though some are over-confident. However, from the results of observations and interviews, it was found that students with special needs had doubts, tended to avoid, lack of self-initiative, were easily anxious, had low self-confidence, lacked enthusiasm, and lacked the courage to appear in front of a crowd.
Therefore, the school provides group and individual counseling guidance services that are carried out regularly. The school also includes teaching aids and a place to practice to improve their reasoning skills, thinking skills, and physical abilities to be further enhanced by showing self-confidence. [16]

Counseling guidance services are carried out in groups and individually. The implementation of counseling guidance services carried out by classroom teachers, namely responsive services and support services. Guidance and counseling will be carried out on Saturdays. Although it does not rule out, it can be carried out situational depending on students' condition at that time. The teacher said that the implementation of guidance services in groups was to help other students who were less confident, so they did not dare to ask questions, so they did not understand the material. Peer tutors are applied by teachers, have a good impact on students. The results obtained were that students were able to volunteer to answer questions on the blackboard and ask the teacher about material that had not been understood. Following the opinion of [17], guidance can be interpreted as a process of assisting individuals to achieve the understanding and self-direction needed to make maximum adjustments to schools, families, and communities to apply these adjustments in their daily life.

Teachers conduct individual counseling services personally with students in separate offices or rooms. According to the counseling guidance plan, the teacher provides counseling to students by advising them to change their attitude to be more confident. The teacher also provides rewards in learning activities to increase students' self-confidence. The teacher motivates by using various ways so that students who do not have confidence then become convinced and can achieve learning goals. This is done by inserting positive words, and the teacher also shows supportive body gestures by giving a thumbs up and making physical contact such as stroking his head or tapping his shoulders. This will stimulate students' enthusiasm for learning. The teacher's job is not easy to increase self-confidence.

The role of the SDLB B Kranji teacher is to provide constructive advice or messages. The teacher also conveyed that in offering guidance to students again using concrete examples, this was done to understand students with special needs directly, for instance, in the form of audiovisuals such as videos of successful figures or figures with disabilities who have succeeded. This will increase students' confidence that each individual has and can do everything, and when they have a sense of will and trust in their self-potential or self-concept, it grows. This method can inspire all students to be more enthusiastic in carrying out their duties and study more actively to achieve their dreamed goals. This is in line with the opinion according to [18] that the role of the teacher as an educator is a role related to the tasks of providing assistance and encouragement (supporter), the study of supervising and coaching (supervisor), and increasing student self-confidence to be suitable for student involvement in the learning process. The principal also explained how to guide each teacher. Differently, this is because each teacher needs to adjust to the character of students with special needs who will be mentored. The class teacher considers different names in handling guidance optimally to achieve learning goals. The principal prepares plans to implement guidance and counseling services for students with special needs as character building. This is in line with [19] that counseling guidance services aim to plan study completion activities, career development, and life development in the future and then develop them to adapt to the educational environment, community environment or work environment and be able to cope with obstacles and difficulties faced in learning.

Increasing students' self-confidence can also be done through competition activities between schools or classes. The teacher gives students guidance in competition activities. This needs to be done so that students are brave and confident to make works of art and even appear
in front of many people. The teacher said that increasing students' self-confidence was by fostering or guiding both in learning and in competitions. According to [6], this is in line with the opinion regarding self-confidence, which is a mental attitude of optimism from students' ability to solve everything and their ability to make adjustments to the situation at hand.

3.2 The Role of Classroom Teachers in the Implementation of Guidance and Counseling in Forming Discipline Character

The classroom teacher's role is to provide subject matter and gives counseling guidance to students with special needs. Implementing counseling guidance services at SDLB B Kranji is critical, especially in fostering disciplinary attitudes for students with special needs. Teachers have a big responsibility in promoting student discipline so that students can obey the rules that apply in school. The field is essential and needed by students with special needs to comply with applicable regulations.

The principal is involved in dealing with students with special needs who violate school rules. The efforts to foster student discipline that have been carried out by school principals and teachers are proven by students who have complied with school rules, wear uniforms according to their schedules, come to school on time, do homework, enter class on time, and do not skip truancy. The teacher will punish the violation of discipline. Punishment is given by students so that students don't repeat the same mistakes. A teacher's warning so that students do not violate the rules and students do not repeat their mistakes. School rules are made so that students have an awareness that it is essential to have good discipline. In line with [20] opinion, the field is the awareness and willingness within oneself to comply with applicable rules, not pressure from outside. Changes in disciplinary attitudes include actions taken by the teacher, such as being reprimanded, advised, even punished to comply with the rules that apply in schools. This is in line with [21], arguing that indicators of disciplinary attitude include: 1. Attendance of students at school. The presence of students at SDLB B Kranji was on time. Although there are still some students who sometimes are still not on time. 2. Dress neatly and entirely in uniform. Based on interviews with students, students have worn school uniforms according to their schedule because it is part of school rules that must be obeyed. 3. Obey the school and class laws. 70% of students have an excellent disciplined attitude, which means they have followed the rules in school.

Fostering a disciplined attitude in elementary schools, of course, cannot be separated from the school in making changes [22]. Discipline is not only in coming to school on time, wearing uniforms according to schedule, doing homework, and not skipping school. But the field in the religious side can also be done simultaneously, such as discipline in memorizing short letters. This activity is so that students have the responsibility to learn. The implementation of counseling is carried out from grade 1 to grade 6 and is handled directly by each class teacher. Counseling guidance is carried out not only for students with special needs who experience problems but also for students who excel and receive advice. The implementation of counseling guidance services uses different methods and methods. Judging from the issues that occur and student characteristics first. The problems that occur are not always the same, and students who have problems are not the same. Therefore, each class teacher uses their ways of dealing with students. Guiding students with special needs is not only in the academic section but also includes non-academics. The teacher carries out recommendations when learning occurs. If there are students who do not understand the material, the teacher repeats the material to understand it better. Providing advice when students are not doing homework so that students are motivated to be better. In the non-academic part of the competition, the teacher offers
motivational guidance so that students want to take part in the contest and even get a winner. Guidance is given to all students in both classical and individual ways. Individual teacher guidance provides direction, advice, motivation, and is carried out outside teaching and learning activities. Classical or group guidance, namely, the teacher provides leadership, inspiration, and advice between lessons and outside learning in the classroom. In line with the opinion of [22], guidance is an effort made by mentors to direct individuals in a better direction to achieve optimal development.

Counseling is carried out to help solve problems in students who are truant or do not do homework. The teacher seeks information from the parents of students to find out why students are truant. Handling teachers to students who do not do homework, the teacher asks students to do it later after school. Counseling is handled by teachers in the teacher's room, classroom, and principal's office. Usually, students who experience problems are given reprimands, advice, and punishments that deter students. So that students have a good personality both inside and outside of school. In line with the opinion of [22] that the purpose of counseling is so that students avoid various problems, such as problems related to symptoms of mental illness (neurons and psychoses), social and spiritual, or in other words so that each individual has a healthy mind. One of them is by approaching and coaching students because of students' characteristics with special needs, how to handle it cannot be taken once but gradually and continuously. Students are made like friends so that students are open to the teacher. Make students comfortable with the teacher so that it is easier to find information from students. The implementation of counseling is supported by the collaboration of the school with the parents of students. The cooperation aims to make activities related to parents run well. Class groups forming social media groups to connect parents, students, and schools can be conveyed directly. Collaboration must be carried out so that school relations with parents and students can be well established.

3.3 The Role of Class Teachers in the Implementation of Guidance and Counseling in Forming Achievement Motivation Characters

The teacher has an essential duty to guide and motivate, such as giving encouragement to students, creating a pleasant atmosphere while learning takes place, and giving praise. The teacher is also a facilitator for students to form a character of achievement motivation both in the academic and non-academic fields. The teacher has a big responsibility, namely the teacher's role in educating and guiding, but the teacher must provide an excellent example to students so that students have moral values, discipline time by leaving school on time, dressing neatly, and not violating existing regulations. School. In addition to providing learning to students, class teachers also have a role in familiarizing and providing good things for students, such as giving advice and guidance that fosters student enthusiasm and creates a suitable environment for students to behave and behave according to their age. Teachers always guide and support students to achieve achievements in both academic and non-academic fields. The teacher is very kind and teaches patiently so that students understand and understand the learning given.

Guidance and counseling can help students solve a problem they face to provide a change and sound development. The teacher offers individual guidance and counseling by maintaining the confidentiality of the issues and providing solutions for students in separate rooms where no one else is on for breaks or from school. The teacher provides guidance and counseling classically between lessons by dividing the group of teachers into each group to ask about students' difficulties to be adequately resolved. After learning is complete, the teacher evaluates the teaching that has been passed. The implementation of guidance and counseling is carried out by the classroom teacher as a whole. Guidance and counseling services are provided
classically in between lessons by dividing groups of students in each class. These activities can make students develop better individually with students who have low achievement motivation or are included in the slow learner category. As with the opinion of [24] argues that guidance and counseling are assistance services for students, both individually and in groups to be independent and develop optimally, in personal direction, social advice, study guidance, and guidance. careers, through various types of services and support activities, based on prevailing norms. Guidance and counseling really help students with special needs in solving a problem in learning such as being afraid to ask material that students do not understand, or when students online classroom teacher as a whole carries out the implementation of guidance and counseling teacher always gives direction, feels comfortable and confident in every lesson to students with special needs by clapping, singing together, games by linking learning, and quizzes with prizes students' enthusiasm for learning. Students are not afraid to ask the gain with the teacher's al. ys trying to answer questions from students with full confidence and tenderness to understand and grow high motivated, ion to achieve achievement.

Researchers at SDLB B Kranji met character values that appear in guidance and careers for student achievement motivation. Students try to achieve achievements, seen from students always a long time, completing assigned assignments on time, following school regulations, accepting appointments that the teacher gives with enthusiasm and not being overwhelmed, being active when learning takes place, often participating in competitions in the field academic and non-academic with full confidence, and enthusiasm for learning by doing additional lessons to be able to beat other schools. This is following [25] argues that achievement motivation is manifested in students' driving force to seek progress in learning and pursue maximum levels of achievement self-enrichment and self-respect. The teacher guides in learning to foster student achievement motivation by showing a competition video that seniors participated in so that students with special needs are motivated to participate in the competition by honing students' abilities in the academic field.

Students who take part in competitions have a more mature experience than other students. The sense of pride from teachers and parents can also make students with special needs very proud and happy about the hard work that these students do in participating in the competition. The awarding of awards is in the form of certificates and trophies from several battles that have been experienced and won. The cup is placed in a glass cabinet to be seen by the students to motivate them to achieve. The school principal also always supports students by becoming facilitators, providing space for training, providing the needs needed in competitions in the form of material that students need to learn for the competition, and preparing the administration required for the competition. So that students only focus on participating in a battle to get a champion. This is to motivate students with other special needs to join in achievements such as other friends who have participated in competitions with enthusiasm for learning, do assignments well, work on practice questions for matches prepared by teachers, study groups, and set targets. achievement for students to achieve the desired achievement. [22].

4 Conclusion

SDLB B Kranji teachers provide counseling guidance services through responsive services and support services. Teachers provide responsive services that require immediate guidance. SDLB B Kranji teachers provide responsive advice when learning occurs in class, not to be left
behind in lessons. Support services are used by SDLB B Kranji teachers because there are no special learning hours for counseling so that class teachers can guide learning to students. Character building in elementary schools is significant because students begin to form characters such as caring for fellow friends, behaving politely to teachers, school principals, and older people, especially students with special needs. Character building in students with special needs at SDLB B Kranji is carried out in every subject, not only in Civics and Religion learning. The teacher provides examples by relating to the material being taught so that students can follow well. Character education is an effort to instill good habits so that students with special needs can behave and act based on the values that have become their personalities.

References


Media Literacy Profiles of Biology Pre-Service Teacher Candidates in the 21st Century in the Biology Education Departement, Universitas Muhammadiyah Purwokerto

Listika Yusi Risnani
{listikayusirisnani@ump.ac.id}

Muhammadiyah University of Purwokerto, Jalan Ahmad Dahlan, Kembaran, Purwokerto 53182

Abstract. Prospective teachers are essential to have mastery of media literacy related to their teaching assignments, namely developing teaching materials and preparing learning media so that learning messages reach students effectively and efficiently. The purpose of this study was to determine the mastery of media literacy among biology teacher candidate students in the Biology Education Departement, FKIP UMP. This research was conducted in the even semester of the 2018/2019 academic year. The population of this study was students of the Biology Education Departement, FKIP, UMP. The sampling technique used was the purposive non-random sampling, namely all students in the final year (semester 8). Data collection methods are using questionnaires, interviews, and documentation studies. The questionnaire instrument used has been validated using content and construct validity by information technology experts. The results showed the ability to access, the average questionnaire score was 4.24 (good), and the interview results were in a good category. On the ability to analyze the media, the average questionnaire score was 3.50 - 3.81 (good), and the results of the interview were in a low category. On the ability to create media, the average questionnaire score was 2.85 - 3.34 (enough), and the results of the interview were in a good category. This study concludes that the mastery of media literacy in biology teacher candidate students in the Biology Education Departement is in the sufficient to good category.

Keywords: media literacy, 21st Century, students, a pre-service biology teacher

1 Introduction

The 21st Century is a century of globalization and openness characterized by the rapid development of information and communication technology that has influenced and changed various aspects of human life. Digital-based information technology is growing fast. Almost all instruments for research, professional work in various scientific fields have utilized digital technology, including computers, satellite communications, robotics, videotext, cable television, e-mail, electronic games, and electronic-based office machines. The world of life is increasingly connected with authentic information technology via the internet. The internet as a global network contains millions of websites, databases, and various information that allows someone to search, find, manipulate existing ones, create and disseminate new information so that a lot of useful and useless information is available on the internet. The development of internet culture and the Cyber Society that combines the internet with cellular communication
with various hardware innovations have made the internet replace the communication model of social life and even change systems and cultural values and the human spiritual dimension [3]. This raises the main problem faced, namely how a person can get information appropriately and effectively. The ability to choose the right information as needed is more important than just how to get access to that information [12]. Finding appropriate and useful information is closely related to media literacy because data is stored and communicated through a medium.

In education, information and communication technology has been proven to merge the "space and time" factor, which has been an aspect determining the speed and success of mastery of science [3]. According to the Assessment and Teaching of 21st Century Skills (ATC21S), talent, information, and communication technology, the ability to learn and work through social media (digital) networks which are near related to media literacy, are considered skills for living in the world [8]. The same thing is also stated by Trilling & Fadel (2009), which says that there are essential skills that must be mastered by students or students in the 21st Century, one of which is media literacy [17]. Media literacy can understand various media types to communicate messages, choose the right media from several available options, and use the media to convey messages effectively [17]. Media literacy is essential to be controlled by student-teacher candidates considering the main task, namely teaching (transfer of knowledge). Before Teaching, teachers are required to make lesson plans, one of which is learning media. Media is a tool to convey messages or materials. In Primary and Secondary Education, information and communication technology (ICT) is one of the principles of learning to increase learning efficiency and effectiveness [9]. Prospective teachers need to have the media literacy to be able to create ICT-based media. Good mastery of media literacy will make it easier for future teachers to obtain various information that is increasingly open today. Speed, ease, and accuracy of getting information to develop teaching materials will only be accepted if prospective teachers have good media literacy skills. Future teachers who have media literacy are expected to create more meaningful and enjoyable learning. It is also hoped that it will transmit, teach, and print students later to have the same skills needed to be successful in life.

In general, media literacy is the key to mastery of other skills needed for a successful life in the 21st Century, such as information literacy [19]. Besides, media literacy also plays a role in supporting problem-solving efforts and creating new knowledge as one of the keys to life's success in the 21st Century [14] [19].

this is a challenge for tertiary institutions, predominantly the Teacher Training Education Institution (LPTK), to produce qualified teacher graduates equipped with adequate media literacy skills. Mastery of literacy for prospective biology teacher-students is beneficial in studying and doing academic assignments. At the same time, they are still in college and useful when students enter the world of work and become teachers later. This is because the characteristics of the 21st-century job sector prioritize information and knowledge rather than manufacturing services.

A preliminary study by observing students of the Biology Education study program in various generations shows that most students already have smartphones/gadgets and personal laptops, and internet access. However, many students have not utilized the internet optimally to support the learning process. They use the internet more for social networking and entertainment. Some students even complained that they did not have the source of information to complete the assigned assignments. Students take advantage of search engines such as Google to search for information, but most of them have not selected relevant and irrelevant information for reference. When doing studies and assignments, most students use connections or libraries that are less diverse and up to date. This can be seen in the year and the number of bibliographies and when students submit assignments, for example, making papers. Even in early semester
students (semester 1 and 2), it is not uncommon for students to use references from high school books to study and organize assignments. Another finding is that students often use connections from sources that are not suitable as references. They cannot be accounted for legally, such as BlogSpot or WordPress, and rarely use research journals to learn and compile assignments. Another observed phenomenon was that during presentation assignments, both those who served as presenters and non-presenters almost always opened their smartphones to access information and used the information that appeared to ask or answer questions from discussion participants spontaneously without considering the correctness of the data. This indicates the lack of media literacy among students. The unavailability of information regarding information media literacy of Biology Education Department students in UMP. In this study, an instrument will be developed to measure media literacy and explore the extent of mastery of media literacy in UMP Biology Education Department students. The availability of information on media literacy for students is expected to become a reference and considerations for the Study Program in making policies related to learning and reference material in preparing learning designs by lecturers/teaching staff to improve the quality of learning.

The following are indicators used to explore data on mastery of media literacy in student-teacher candidates.

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access media</td>
<td>Students can search, obtain, and collect information using the media.</td>
</tr>
<tr>
<td>Analyze media</td>
<td>Students can understand the purpose of using media.</td>
</tr>
<tr>
<td></td>
<td>Students can test the correctness of different messages in the media.</td>
</tr>
<tr>
<td></td>
<td>Students can understand the values and perspectives of the media.</td>
</tr>
<tr>
<td></td>
<td>Students can understand the influence of the media on beliefs and behavior.</td>
</tr>
<tr>
<td></td>
<td>Students can interpret media messages.</td>
</tr>
<tr>
<td></td>
<td>Students can apply a fundamental understanding of ethical and legal issues when accessing and using media.</td>
</tr>
<tr>
<td>Creating/creating media</td>
<td>Students can understand and take advantage of the appropriate media creation tools, characteristics, and conventions.</td>
</tr>
<tr>
<td></td>
<td>Students can create media effectively as the most appropriate expression and interpretation in a multicultural/diverse environment.</td>
</tr>
</tbody>
</table>

2 Method

This study used a survey research design. The research was conducted in February-June 2019 for the 2018/2019 academic year. This study's sample was 8th-semester students (27 students) in the Biology Education Study Program, FKIP Muhammadiyah University of Purwokerto. The model was taken using a purposive non-random sampling technique considering that the 8th semester was students who had almost taken all courses that were considered representative to be taken data to provide input for improving the implementation of learning in the Study Program. Besides, 8th-semester students have taken instructional media courses, and some students have taken multimedia learning options that are considered closely related to media literacy skills.

The data collection technique uses non-test techniques, namely using questionnaires, interviews, and documentation studies. Distribution of questionnaires using a questionnaire
The instrument is used to explore information on mastery of media literacy in student-teacher candidates. The questionnaire consisted of 72 statement items compiled using a Likert scale (scale five), namely strongly agree (SS), agree (S), neutral (N), disagree (2), and disagree (TS). Before the questionnaire was used to explore data about the media, validation tests were carried out, namely content validation, construction validation by media and IT experts, namely one of the lecturers from the UMP Information Technology (IT) Study Program. Interview techniques and documentation studies were carried out to obtain more detailed information about media literacy according to the questionnaire's answers.

Before the questionnaire was used to explore data about the media, validation tests were carried out, namely content validation, construction validation by media and IT experts, namely one of the lecturers from the UMP Information Technology (IT) Study Program. Interview techniques and documentation studies were carried out to obtain more detailed information about media literacy according to the questionnaire's answers.

The data analysis technique used is the descriptive quantitative analysis and qualitative descriptive analysis. The quantitative descriptive approach was used to analyze the questionnaire's data about the students' mastery of media literacy. The data analysis steps are 1) questionnaire scoring, namely by changing the results of the questionnaire that is qualitative to be quantitative. The scoring guidelines for each item are SS = 5; S = 4; N = 3; KS = 2; TS = 1; 2) calculate the average score of each item according to the media literacy indicator; 3) determine the average score on each statement item based on the assessment criteria guidelines as follows.

Table 2. The Assessment Criteria

<table>
<thead>
<tr>
<th>Value interval</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mi + 1,5 Sbi &lt; X</td>
<td>Very Good</td>
</tr>
<tr>
<td>Mi + 0,5 Sbi &lt; X ≤ Mi + 1,5 Sbi</td>
<td>Good</td>
</tr>
<tr>
<td>Mi – 0,5 Sbi &lt; X ≤ Mi + 0,5 Sbi</td>
<td>Enough</td>
</tr>
<tr>
<td>Mi -1,5 Sbi &lt; X ≤ Mi – 0,5 Sbi</td>
<td>Not good</td>
</tr>
<tr>
<td>X ≤ Mi – 0,5 Sbi</td>
<td>Not good</td>
</tr>
</tbody>
</table>

Source: [11]

Information:
X: actual average score
Mi: The ideal mean
Sbi: ideal standard deviation
Mi: (highest ideal score + lowest perfect score)
Sbi: (highest ideal score - lowest perfect score)

Descriptive qualitative data analysis is presented in the form of descriptions used to analyze the results of interviews and documentation studies on information media literacy at the time of learning.

3 Result and Discussion

The results showed that the media literacy of biology teacher candidate students was in a suitable category with an average score of 3.47 with a standard deviation of 0.68. The standard deviation is quite large, indicating that students' media literacy is controlled unevenly or uniformly. The details of the research results on each part of media literacy, namely the average score on the part of accessing media are 4.24 (very good) with a standard deviation of 0.24, the average score for the aspect of analyzing media is 3.63 (good) with a standard deviation of 0.58 and the average score for the element of creating media is 3.20 (sufficient) with a standard deviation of 0.71 (Fig. 1).
The average score for the ability to access media is 4.24 (very good), the average score for the ability to understand media objectives is 3.62 (good), the average score for the ability to understand the purpose of the media is 3.62 (good), the average score for the ability to test the truth of media messages is 3.63 (good), the average score for the ability to understand the value and the media point of view is 3.56 (good), moderate - The average score for the ability to understand the influence of media is 3.50 (good), the average score for the ability to interpret media messages is 3.64 (good), the average score for the application of ethics and law of media access is 3.81 (good), the average score for the ability to use tools for media creation is 3.34 (good), and the average score for the ability to create media is 2.85 (sufficient; Figure 2).
Research on media ownership shows that biology teacher candidate students have media ranging from 8 to 19 media. 100% of students have their laptops and smartphones. The details are smartphones, laptops, and WhatsApps social media owned by all students (100%), television media, Instagram social media accounts, and Youtube accounts owned by 92.31% of students, Facebook accounts are owned by 84.62% of students, and media online shopping and online motorcycle taxi applications such as Share It, Shopee and Gojek are owned by approximately 53.85 - 73.08% of students. Apart from the top ten media owned by students, there are other media such as magazines, newspapers, radio, and various social media and other applications such as Blackberry Messenger (BBM), Twitter, skype, line, kaskus, grab with varying ownership, namely 7.59 - 38.46% of students (Figure 3).

![Fig. 3. Top Ten Media Owned by Students](image)

The results showed that prospective teachers accessed media with various purposes, namely learning resources related to fulfilling coursework (100%), means of communication, entertainment, searching for news, updating status (92.59-96.30%), uploading photos (88.89%), means of discussion and brainstorming (81.48%), looking for culinary references and means of buying and selling (66.67 - 74.07%) and designing graphics, making videos and providing comments (40.74%). Other purposes of accessing the media are writing blogs or journals, preserving local culture, and promoting (Figure 4).
The results of interviews conducted with students to measure media literacy mastery are as follows.

Table 3. Results of Interviews and Documentation Studies on Mastery of Media Literacy

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessing media</td>
<td>We are seeking, obtaining, and gathering information using the media.</td>
<td>All students (100%) have been able to search for and collect information from various media. All students stated that most often, they access information using internet-based media using their smartphones and laptops. The search engines they often use are google search and yahoo search for reasons that are easily accessible, the available sources of information are many and varied, and both are available with built-in features on their smartphones. All students interviewed (100%) had a Youtube account used to upload videos, but most of the videos were not related to coursework or learning. Books are the second media they access after accessing internet-based information. Students rarely access newspapers, magazines, and television to get information, especially lecture assignments.</td>
</tr>
<tr>
<td>Analyze media</td>
<td>Understand the intended use of the media</td>
<td>All students (100%) have understood the purpose of using media. Students access the media for various purposes. The main goal is to find information or material related to college assignments, get data about celebrity gossip, get the latest news, and entertain soccer matches' video streaming. Students always identify the sender of messages in the media. Still, to know (40%), students think the sender's identity is useful in including it in the reference list (60%). Students have accessed more than one media to test the information's correctness, such as viewing the internet, TV news, and accessing Youtube. All students (60%) admitted that they</td>
</tr>
</tbody>
</table>

Fig. 4. The purpose of accessing the media by students.
had not accurately tested a media message's truth. They claimed to have more confidence in the information broadcast through television media because it was verified before broadcast. Some students (80%) have not been able to judge whether messages in a media contain false information (hoaxes) or not before a body states that the data is fake (Hoax). Able students (20%) assess a media's message as a hoax by identifying people's responses in the comments column and comparing it with messages on other media, especially television shows. All students (100%) admitted that they understood the good and bad grades of letters on the media by looking at the message content and its words. Students rated poorly on media messages that contained provocative content, offending certain racial traits, pornography, and gambling.

Test the correctness of different messages in the media

Students can understand the values and perspectives of the media.

All students (100%) understand that messages in the media can influence a person's lifestyle, starting from clothes, behavior, and beliefs. As many as 20% admitted to having accessed pornographic content through the media.

Students understand the influence of the media.

As many as 100% of students could relay messages in the media after reading or watching them to other people such as friends. Students admit that it is easy to convey news messages, gossip, and entertainment. However, it is challenging to share messages containing subject matter because the lesson messages are quite tricky and consider the consequences if the message is wrong. They also think it has not become a habit/habit to convey messages of subject matter outside of class hours. They consider lecture material to be less attractive to access and report back to others.

Students can interpret media messages.

All students (100%) understand that there are ethics and rules in media access, but all admit that they have never studied them specifically. They are only limited to hearing from various news after violating the law regarding access to and using the media. In practice, all students never use the media to disseminate information that causes hostility to specific groups of people based on SARA, gambling, pornography, gambling, and violence. As many as 20% of students admitted to having accessed and used media containing pornographic content. All students claim to have accessed and used someone's data (friends and siblings) on electronic media such as WhatsApps (WA) without the account owner's permission to extract specific information. 60% of students also claimed to have added content such as status updates to a friend's WA account with the aim of fun or funny. All students (100%) claim to use smartphones for voice recording, taking, and simple video editing using the Viva Video, Ulead, and Movie Maker applications. As many as 60% of students admit that they cannot use image editing applications to edit images/photos. As many as 40% of students claim to have been able (in high school) to create and edit images using a computer through applications such
understand and utilize appropriate media creation tools, characteristics, and conventions

- As many as 100% of students claim to create audio media (recordings), create visual media by taking pictures/photos via cellphones and digital cameras, but have not been able to create poster and chart paintings as media. They prefer to use chapters that are already on the internet and then print them out to learn.

- As many as 100% of students admit that they have not created a film, comic, and three-dimensional model to convey learning messages.

The results showed that access media, especially internet-based media for biology teacher candidates, was in the perfect category with the highest score (Fig. 4) compared to other media literacy aspects. Media access time by students is also relatively high. On average, students access the media every day for 4.46 hours on weekdays and access the media for longer during holidays, namely an average of 7.56 hours/day. This shows that the media has become a primary need for students. Students have a high dependence on finding information through the media, especially the internet [10]. The media most accessed by students are smartphones and laptops connected to internet services. The results of the interview stated that the internet was beneficial in providing various kinds of information. As reported in previous research, it shows that perceived usefulness positively affects internet use among college students. A person will use technology (internet) if the technology provides positive results for its users [13]. The ability to access media is a must in today's era of communication technology development. A person who is unable to access media, especially internet-based media, will miss information. Prospective teacher students as agents of change have curious characteristics and access the media to update information.

Using media as a means of learning, communication and entertainment are the top three media access goals by biology teacher candidate students (Fig. 4). This study's results are consistent with the research reported by Daeng et al. (2017) regarding the use of smartphones in Manado Fispol Unstrat students that students use smartphones to support their learning [5]. Through smartphones, students can easily access the internet to get information that develops anywhere and anytime quickly. Also, smartphones can store various types of files/documents that support study/lecture activities. The research results are similar in that FISIP Mulawarman students often access the media for communication and entertainment purposes [7]. This is possible because communication can be done to reduce saturated, stressful (stressful) conditions. A person who is in a state of stress and anxiety will spend more time on his smartphone to be free from feelings of depression and anxiety [6]. Students will also feel anxious if they don't access the media for a day, especially smartphones. This study's results are supported by research that states a relationship between student anxiety and addiction to media, especially smartphones [16].

Ability to test the truth of a media message. The questionnaire results showed that the ability to test the validity of media messages by prospective teacher students was in a good category (Fig. 1). Different products were delivered from the interviews results that all students stated
that they could not test the truth of media messages before there were parties who said that information was fake or Hoax (Table 3). Students have made efforts to try the fact by looking for the same information in various media. Still, a Hoax is a lie that is deliberately created and disseminated through internet media irresponsibly [15]. This hoax news can not only mislead prospective biology teacher students but society in general. Hoax news is prepared to create hatred, anxiety, suspicion, confusion, and the critical point that it can divide the nation's unity and integrity. The ability to test the correctness of messages in the media is not easy, especially now that every individual who has internet services can become a publisher who produces/creates information messages and disseminates news through internet-based media. This ability is important for prospective teachers. They hope that when presenting the material as teaching material to students, it does not contain false news or information that can profoundly impact students' attitudes, behavior, and even beliefs. The ability to test the truth of media messages is still low due to a lack of knowledge about official websites and hoax news spreading sites, lack of knowledge about ethics, editorial provisions in carrying out journalistic duties [4]. The absence of socialization on how to identify hoax news and how to respond to it in the Biology education study program can cause such student ability. One of the efforts that can be made is the effort to prevent hoax news through a hoax detection application [15] such as the TurnBackHoax.id mobile application designed by Mastel (Indonesian Telecommunications and Informatics Society) and published in a press release from the Ministry of Communication and Informatics [4].

Ability to judge media messages. The results showed that the ability to assess media messages was in a good category based on the questionnaire results (Fig. 1) and the results of the interviews (Table 3). Setting media messages is the ability to judge the merits of media messages from various points of view. This ability is essential considering that adolescents, including students, recognize outside life and get socialization of the values adopted by society through the reality they see and learn through the media [7]. Students identify the pros and cons of a message through construction, such as the words used in the news and the content of the message.

Ability to understand media influences. The results showed that the understanding of media influences on biology teacher candidate students was in a good category based on the questionnaire results (Fig. 1) and the results of the interviews. Students understand and feel for themselves the media's influence on lifestyles, such as the way they dress, behavior, and beliefs. Models of artists influence how young people dress in a film or specific advertising models that they see on television and social media. They are aware of the positive influence and negative influence of media messages. Students admit that they often neglect or postpone worship such as prayers due to being too busy accessing social media. This shows that the media can be said to be a "new religion." Islam as a religion is still adhered to. The behavior of daily life has always been heavily influenced by the media, such as making the media (social media) a place to complain about happiness and problems in life through the statuses that are made. Whether we realize it or not, this dependence on media is like a religious person and has become the media as its "new religion" [18].

The ability to interpret media messages in either category is based on questionnaires (Figure 1) and interviews (Table 3). The interviews showed that students easily interpreted media messages containing news and entertainment messages and communicated them back to friends. However, students have difficulty interpreting media messages and relaying them to friends if their statements are related to lesson messages. This is presumably because the lesson's announcement is not considered attractive, so it does not motivate students to access and learn it. Motivation, interest, and insufficient attention to learning messages in a medium will also
have a low impact on understanding and interpretation skills, so that message materials tend to be slower to be conveyed to other people [2].

The ability to understand ethics around the access and use of media for prospective teacher-students is in a good category based on a questionnaire’s results (Figure 1). Different results were obtained from the effects of interviews. Students were able to mention various ethics and rules in access to and use of media, but they had not been implemented significantly. Students dare to take action to open social media accounts and other people's media devices without permission by adding and or reducing the content in them. This is presumably because students are still limited to having only heard of but have never studied the Law on Electronic Information and Transactions (ITE Law). Ethics in accessing the media as part of media literacy in education is vital considering that Indonesia has passed laws and regulations governing electronic transactions and imposing sanctions for people who misuse information media to harm others or take action against the law [1].

Ability to utilize tools, characteristics, and appropriate media creation conventions in both categories based on the questionnaire results (Fig. 1) and the results of the interviews (Table 2). However, creating media effectively is insufficient (Fig. 1) and an inadequate category (Table 3). The ability to create media is related to the production and distribution of media messages and critical communicative competencies for prospective teachers. Students can use various image and video editing applications to convey news, including learning letters. They knew this in high school. They only applied it through lecturers' assignments in specific subjects such as practicum courses, learning media, entrepreneurship, environmental knowledge, and educational management. All students admit that they have not created posters, charts, three-dimensional media/models, and make films to messages. As many as 60% of students admitted that they had used charts in their teaching microteaching courses, the charts used were not self-made but borrowed from the laboratory. Similar results have been reported that Communication Science study program students' ability is still low or far from what was expected [7].

The current media literacy controlled by prospective teacher students can indicate that learning in the Biology Education Study Program has not led to media literacy provision. The absence of unique courses that teach about media literacy demands that every lecturer who teaches specific courses must equip students with media literacy skills. This is due to media literacy as an essential skill for students to master to achieve a successful life in the 21st Century [17]. Apart from learning at school or campus, several factors can influence a person's mastery of media literacy, namely the introduction of media for the first time, the person who introduced the press, the rules for using media (internet) from parents, internet access times and frequently visited internet sites [10].

The ability to access media is classified as useful, but analyzing media and creating media is still not as expected. Several ways can be done as a follow-up to the results of such research, such as 1) raising awareness of the positive and negative impacts of media use through class discussions and regular discussions as a forum for sharing and brainstorming related to media, especially digital media, 2) providing understanding to students about the purpose of media being made, how media messages/information are made, who and why media messages were made, 3) inviting students to analyze notices that appear in media, especially online media, 4) inviting students to get used to checking the correctness of information from reliable sources 5) asking students to understand the rules and code of ethics of accessing and using the media so that students are not trapped in posting messages that are not following the regulations and can harm themselves [10].

Efforts to improve media literacy above can be made through student associations in the Study Program and lecturers. Lecturers can routinely insert them between learning certain
subjects, either directly or indirectly, such as through assignments to students. The ability to access media that is already good is expected to be an illustration for lecturers not to hesitate to carry out learning and projects related to the use of media, especially digital media and online media such as e-learning learning and learning through social media, which has not been done much (25%). The ability to create media for prospective teacher students who are still not expected is expected to provide input for lecturers, especially lecturers who teach media and multimedia courses to improve learning that emphasizes project-based learning, namely projects making various learning media.

4 Conclusion

From this study, it can be concluded that the student's high-ability can represent their ideas visually. Meanwhile, students with low-ability have not been able to express their ideas optimally. For students' verbal representation is still less, especially when writing it in text. Then for the ability of symbolic representation, students can represent symbolically and solve problems given systematically. We suggest continuing the research about how students' mathematics representations in more subjects.

References

Development of Inferential Statistics Teaching Materials Using ADDIE Model

Malim Muhammad\textsuperscript{1}, Lukmanul Akhsani\textsuperscript{2}
{malim.muhammad@gmail.com\textsuperscript{1}, luk_akh@yahoo.com\textsuperscript{2}}

Department of Mathematics Education, Faculty of Teacher Training and Education, Universitas Muhammadiyah Purwokerto

Abstract. Statistics learning is one of the compulsory lessons learned at the Mathematics Education Department of Universitas Muhammadiyah Purwokerto for undergraduate students. This study aims to produce statistical teaching materials for mathematics education research, especially for Inferential Statistics that are suitable for use in lectures. The research method used is the method of research and development. The teaching materials development model used in this study uses steps adapted from ADDIE research and development model, which consists of five stages, namely Analysis, Design, Development, Implementation, Evaluation. The results of the evaluation were obtained from suggestions from lecturers and students during the trial, so that from this evaluation stage a final revision was carried out. Valid, the results of the validation of material experts with an average of 3.26 are in the very valid category, because $3 \leq M \leq 4$, so the material in the media is said to be very valid, while the results of the validation of media experts with an average of 3.18 are in the very valid category, because $3 \leq M \leq 4$, so this teaching materials is said to be very valid. Effective, this is said to be effective because the teaching materials is rated by students with an average percentage of positive responses of 83.27%. Practical, it is said to be practical because the percentage of teaching materials implementation is 80.43%.

Keywords: Inferential Statistics, Teaching Materials, ADDIE Model

1 Introduction

Research and Development is a process or steps to develop a new product or improve an existing product [1]. The purpose of this method is used to produce certain products in testing the effectiveness and usefulness of the product, and to find out how respondents respond to the products being developed [2]. The development model is the basis for developing the product to be produced. Development models can be in the form of procedural models, conceptual models, and theoretical models. The procedural model is a model that is descriptive in nature, showing the steps that must be followed to produce a product. The conceptual model is an analytical model that states the components of the product, analyzes the components in detail and shows the relationships between the components to be developed. Theoretical model is a model that describes a frame of mind based on relevant theories and is supported by empirical data [3].

There are many types of teaching materials available such as books, modules, and textbooks. Learning will run effectively and efficiently if it uses teaching materials that suit the needs of students, supports the competencies to be achieved by students, has a systematic
description, standardized tests and appropriate learning strategies for students. Therefore, a lecturer must be able to prepare teaching materials and learning strategies that are suitable in every lesson in class [4]. The teaching material from the handout only describes the subject matter without any training as independent learning. This is in accordance with the opinion of Komalasari (2010) that teaching materials circulating in the market are oriented towards formal learning materials and are taken from supporting disciplines, but do not pay attention to learning materials taken from the environment where students live so that the conceptual relationship learned by students through this teaching material, it is not related to the daily life of students [5].

Anwar stated that the characteristics of the learning module are as follows: (1) Self-instructional means that students are able to teach themselves, not depending on other parties; (2) Self-contained means breaking the learning material from a single unit of competence to be learned contained in one intact module; (3) Standalone means that the developed module does not depend on other media or does not have to be used together with other media; (4) Adaptive means that the module should have high adaptive power to the development of science and technology; and finally (5) User friendly, meaning that the module should also meet the rules of being comfortable with the wearer [6].

Learning to use modules has many benefits, students can be responsible for their own learning activities, learning with modules really appreciates individual differences, so that students can learn according to their level of ability, so learning will be more effective and efficient. Lasmiyati and Harta explain the advantages of learning with modules, namely (a) the module can provide feedback so that students know their shortcomings and immediately make improvements, (b) in the module set clear learning objectives so that student learning performance is directed in achieving learning goals, (c) modules that are designed to be attractive, easy to learn, and can answer needs will certainly lead to student motivation to learn, (d) modules are flexible because the module material can be studied by students in different ways and at different speeds, (e) cooperation can be established because with modules competition can be minimized and between learners and learners, and (f) remedies can be done because modules provide sufficient opportunities for students to be able to find their own weaknesses based on the evaluation given [7].

Munadi argues that media comes from Latin, namely midius which means middle, introduction, or intermediary. In the context of learning Susilana and Riyana defines teaching materials as anything that can convey and stream messages from sources in a planned manner so as to create a conducive learning environment where recipients can carry out the learning process efficiently and effectively [8]. More specifically, the notion of media in the learning process tends to be interpreted as graphic, photographic, or electronic tools to capture, process, and reconstruct visual or verbal information [9].

The use of appropriate instructional media is a strategic step to improve national education standards, especially standard processes, facilities and infrastructure. Discuss learning to accommodate the concept of teaching (teaching) and the concept of learning that is adjusted to the activities of students [10]. Therefore, in the learning system there are components of students, objectives, materials to achieve goals, procedures, and media that must be developed. Learning designed by facilitating independent learning students can train them to become lifelong independent learners, and in turn they become important components for realizing a learning society. Sadiman stated that the teaching materials of their procurement readiness are grouped into two, namely media that are already a trading commodity and are in a ready-to-use state, and media designs because they need to be specially designed and prepared for specific
learning purposes or objectives. (media by design). Module as one of the teaching materials has one principle, namely the principle of independent learning [11].

One of the subjects in Mathematics Education Department at Universitas Muhammadiyah Purokerto is Inferential Statistics course. Hearing the word Statistics is like a scourge that must be learned. In fact, the use of Statistics was known before the 18th century, at that time the state of Babylon, Rome, issued records of names, ages, sexes, occupations and number of family members. In Indonesia, the introduction of statistics has been included in the elementary school mathematics curriculum since 1975. This is because the environment around us is always related to statistics [4].

According to Lyman and Longnecker states that, Statistics is a branch of science that studies how to plan, collect, analyze, interpret and present data and draw conclusions based on data collections and analyzes carried out. Statistical methods are procedures used in collecting, presenting, analyzing and interpreting data. Meanwhile, Statistics serves only as a tool. The role of statistics in research remains as a tool. This means that statistics are not the goal that determines other components of research. Therefore, which plays a role in determining the problem that is sought answers from the research objectives itself. Statistics can be useful in designing models, formulating hypotheses, developing data collection tools, compiling research designs, determining samples, and analyzing data, which are then interpreted so that they are meaningful [12].

Inferential Statistics has the aim of drawing conclusions. Before drawing conclusions, an assumption is made obtained from descriptive statistics. Examples of Inference Statistics problems include: (a) Statistical Estimation, (b) Hypothesis Testing (c) Forecasting by Regression. Somantri and Muhidin state that Inference Statistics discusses how to analyze data and make decisions (related to parameter estimation and hypothesis testing [13]. Meanwhile, according to Sudijono, Inference Statistics are statistics that provide rules or methods that can be used. used as a tool in order to try to draw general conclusions, from a set of data that has been compiled and processed [14].

2 Method

The type of research used in this research is research and development, starting from data collection, interpretation data, and interpretation research results. Location of this research was conducted at Universitas Muhammadiyah Purwokerto. Sample used in the study was 30 students that take inferential statistics courses.

2.1 ADDIE Model Procedure

The development model is defined as a conceptual design process in an effort to increase the function of existing models, through the addition of learning components that are considered to improve the quality of achieving goals [15]. Based on product development steps, the ADDIE research and development model is more rational and more complete than the 4D (Define, Design, Development, and Disseminate) model from Thiagarajan. This model can be used for various forms of product development such as models, learning strategies, learning methods, media, and teaching materials [16].
2.1.1 Analysis
The main activity at this stage is to analyze the need to develop new learning models and to analyze the feasibility and requirements for developing new learning models. The development of a new learning model begins with a problem in the learning model that has been applied. Problems can occur because the existing learning model is no longer relevant to the need for advice, learning environment, technology, student characteristics and so on.

2.1.2 Design
The design of the learning model at the design stage is similar to designing teaching and learning activities. This activity is a systematic process that starts from setting learning objectives, designing scenarios or teaching and learning activities, designing learning tools, designing learning materials and learning outcome evaluation tools. The design of this learning model is still conceptual and will underlie the subsequent development process.

2.1.3 Development
Development in the ADDIE model contains activities for the realization of product designs. The activity at the design stage is to compile a conceptual framework for the application of a new learning model. Activities at the development stage are conceptual frameworks that are realized into products that are ready to be implemented. For example, if at the design stage a new conceptual model has been designed.

2.1.4 Implementation
The activity at this stage is to implement the designs and methods that have been developed in real situations, namely in class. During implementation, the design model that has been developed is applied to the actual conditions. The material is delivered according to the new model being developed. After applying the method, an initial evaluation is then carried out to provide feedback on the implementation of the next model.

2.1.5 Evaluation
Evaluation is carried out in two forms, namely formative and summative evaluation. Formative evaluation is carried out at the end of each face-to-face (weekly), while summative evaluation is carried out after the activity ends as a whole (semester). Summative evaluation measures the final competence of the subject or learning objectives to be achieved. The results of the evaluation are used to provide feedback to the model users. Revisions are made in accordance with the results of the evaluation or the needs that have not been met by the new model.

2.2 Product Trial Design
Product trials are intended to achieve valid criteria for blended-based learning products. The testing phase is carried out as follows:

2.2.1 Alpha Trial
For alpha testing, it is carried out by material experts and media experts, it can also be done by observers and parties who have the competence to evaluate the products being made. The results of the evaluations that have been carried out as the basis for making the first revision.
2.2.2 Beta Trial
For beta testing, it is carried out on a large scale by observers and students. The test results are used to make the final revision as a medium that is ready to be applied in a wide environment.

![Diagram of Product Development for Inference Statistics Teaching Materials Using ADDIE Model]

2.3 Research Instruments
The researcher prepared several instruments based on the guidelines that had been designed to obtain the necessary data. The instruments in question are material validation sheets, media validation sheets, student activity observation sheets, student response sheets, observer response sheets, and student learning outcomes tests.

2.3.1 Learning Material Validation Sheet
This instrument is used to obtain information about the validity of learning materials based on expert and practitioner assessments. The information obtained through this instrument can be used as material for consideration in revising learning materials oriented to the ADDIE development model developed so that it is suitable for use. On the learning material validation sheet, the two validators provide several assessments of several indicators including: content feasibility, and presentation feasibility. Each indicator has an instrument. The two validators are asked to write the appropriate score by giving a check mark on the appropriate row and column, that is, the validator is given a choice in the assessment column as very good, good, sufficient, lacking and very poor. The validator is then asked to provide a general assessment conclusion with the categories that can be applied without revision, can be applied with minor revisions and cannot be applied.

2.3.2 Teaching Materials Validation Sheet
This instrument is used to obtain information about the validity of teaching materials based on expert and practitioner assessments. The information obtained through this instrument can be used as material for consideration in revising the ADDIE development model-oriented teaching materials that was developed so that it is suitable for use. On the teaching materials
validation sheet, the two validators provide several assessments of several indicators including: optimization of learning objectives, media effectiveness, availability of media used, quality of media techniques and student characteristics. Each indicator has an instrument. The two validators are asked to write the appropriate score by giving a check mark on the appropriate row and column, that is, the validator is given a choice in the assessment column as very good, good, sufficient, lacking and very lacking. The validator is then asked to provide a general assessment conclusion with the categories that can be applied without revision, can be applied with minor revisions and cannot be applied.

2.3.3 Student Response Questionnaire

Student responses to modules can be found through a questionnaire. Student response questionnaires are compiled to collect one of the supporting data for the effectiveness of using teaching materials on the subject of building space with the ADDIE development model. The questionnaire was distributed to students after the last meeting to be filled in according to the instructions given. Student responses include student opinions on the learning process using teaching materials on the subject of building space with the ADDIE development model and the ease of understanding problems. The results of this questionnaire can be used as material for consideration to improve teaching materials and other supporting devices.

2.3.4 Observer Response Questionnaire

The observer response questionnaire was used to obtain supporting data on the effectiveness of using teaching materials on the subject of building space with the ADDIE development model. The questionnaire was distributed to the model observer after the last meeting was completed to be filled in according to the instructions given. The results of this questionnaire can be used as material for consideration to improve teaching materials and other supporting devices. This data can help in obtaining data on which aspects of the teaching material components and other supporting devices that need to be revised.

2.4 Data Analysis Techniques

2.4.1 Validity Data Analysis

The activities carried out in the process of analyzing the validity of the device data quoted from [17] are as follows:

1) Recapitulate the results of the expert's assessment into the table: Aspects (A_i), Criteria (C_i), and the results of the assessment (V_ij)

2) Finding the mean of the assessment results from all validators for each criterion using the formula

\[ \bar{C}_i = \frac{\sum_{j=1}^{n} \sum_{i=1}^{m} V_{ij}}{n} \]  \hspace{1cm} (1)

Where:
\[ \bar{C}_i = \text{average of the } i\text{-th criteria} \]
\( V_{ij} \) = the score of the results of the assessment against the i criteria by the j assessor
\( n \) = number of evaluators

3) Finding the average aspect using the formula

\[
\bar{A}_i = \frac{\sum_{j=1}^{n} \sum_{k=1}^{n} \bar{C}_{ij}}{n} \quad (2)
\]

Where
\( \bar{A}_i \) = average i-th aspect
\( \bar{C}_{ij} \) = average for the i-th aspect by the j-criterion
\( n \) = number of criteria in the ith aspect

4) Finding the average of the total using the formula

\[
\bar{X} = \frac{\sum_{i=1}^{n} \bar{A}_i}{n} \quad (2)
\]

Where
\( \bar{X} \) = total average
\( \bar{A}_i \) = average for the ith aspect
\( n \) = many aspects

5) Determine the validity of each criterion or the average aspect or total average based on the validity category

\[ 3.5 \leq M < 4 \rightarrow \text{Very valid} \]
\[ 2.5 \leq M < 3.5 \rightarrow \text{Valid} \]
\[ 1.5 \leq M < 2.5 \rightarrow \text{Not valid} \]
\[ M < 1.5 \rightarrow \text{Invalid} \]

Information:
\( M = \bar{K}_i \) to find the validity of each criterion
\( M = \bar{A}_i \) to look for valids every aspect
\( M = \bar{X} \) to find the validity of all aspects
The criteria used to state that teaching materials and learning devices have an adequate degree of validity is the average value of validity for all minimum aspects in the fairly valid category and the validity value for each minimal aspect is in the valid category. If it does not meet these criteria, it is necessary to revise it based on the advice of the experts or by looking back at the aspects whose score is insufficient. Then re-validated and then analyzed again.

2.4.2 Analysis of Student and Observer Response Data

Student and observer response data were obtained from student and observer response questionnaires to learning activities, and then analyzed using descriptive statistics in the form of percentages. Activities undertaken to analyze student response data are as follows:

1) Counting the number of students who gave positive responses according to the aspect being asked, then calculating the percentage using the formula: 

\[ \text{percentage of response} = \frac{\text{number of positive responses}}{\text{total number of respondents}} \]

2) Determine categories for positive responses from students and observers by matching the percentage results with the specified criteria. The response criteria for students and observers (RS) were adapted from Nurdin Asyad (2016) with the following conditions:

\[ 0.5 < RS \rightarrow \text{Not very positive} \]
\[ 0.5 \leq RS < 1.5 \rightarrow \text{Not positive} \]
\[ 1.5 \leq RS < 2.5 \rightarrow \text{Quite positive} \]
\[ 2.5 \leq RS < 3.5 \rightarrow \text{Positive} \]
\[ 3.5 \leq RS \rightarrow \text{Very positive} \]

3) If the results show that the student's response has not been positive, then a revision is made to what is being developed. The criteria established to say that students have a positive response is that more than 50% of students give a positive response to at least 70% of the number of aspects asked. Students' positive responses to the use of teaching materials are said to be achieved if the positive response criteria of students are met.

3 Result and Discussion

This study aims to develop learning-based media GeoGebra in cone section material. The research and development procedure this is an adaptation of the ADDIE research and development steps developed by Dick and Carry in designing learning systems, which consists of five stages, namely Analysis, Design, Development, Implementation, Evaluation.

3.1 Analysis

The first stage in this research and development is the needs analysis stage by observing students taking Inferential Statistics courses. The results of this analysis will become a reference in the development of SPSS-based interactive teaching materials. The results of observations made by researchers are still minimal in the use of instructional media. Therefore, researchers think of developing new and more interactive teaching materials and attracting student interest and curiosity about teaching learning materials.
3.2 Design
The Second stage is a follow-up to the analysis stage. In the process of design teaching materials, a design sketch is needed to help make teaching materials. The first thing to do is formulate SMAR learning objectives (Specific, Measurable, Applicable, and Realistic). Furthermore, compiling a test, where the test must be based on the learning objectives that have been formulated. Then determine the appropriate media learning strategy to achieve the goal.
In addition, other supporting sources are also limited, such as relevant learning resources, what kind of learning environment should be. All of this is contained in a single document called a clear and detailed blueprint. Design is the second step of the ADDIE learning system design model.

3.3 Development
In this development stage, there are several things that are done, including:

3.3.1 Making Teaching materials
Media that have been designed by researchers and produce prototypes which are then created and developed. This media was developed using the SPSS application. The content of this teaching materials consists of materials obtained from various related sources.

3.3.2 Product Eligibility Validation
After the teaching materials has been made, validation of the feasibility of the product is carried out. Validation of teaching materials is carried out by expert validators and theoretical and practical considerations. Expert validators consist of media expert validators and material experts.

3.3.2.1 Material Expert Validation
There are 2 material experts in the teaching materials validation process using SPSS software. The material validation is related to the material releasing aspects. Validation by eligibility service material experts, material experts also provide comments and suggestions for improving the media. The results of the validation carried out by material experts can be obtained from the material relevance aspect obtained by an average of 3.26 which is included in the valid category.

3.3.2.2 Validation of Media Experts
There are 2 media experts in the validation of teaching materials using SPSS software. Validation by media experts is related to the appearance of the media. Validation by eligibility service material experts, media experts also provide comments and suggestions for improving the media. The results of the validation carried out by material experts can be obtained from that the media aspect is obtained by an average of 3.18 which is included in the valid category. So that in total, teaching materials using SPSS software that has been developed by researchers can be tested.

3.4 Implementation
This stage is a continuation of the Development stage. At this stage, all media designs that have been developed are applied after revision. Teaching materials using SPSS software that has been developed, implemented in real situations in class. However, at this stage, researchers only conducted product trials on small groups (limited trials) by looking at the responses from the lecturers and the responses from students to the teaching materials that had been developed.
Trial that corrects to see the level of practicality in the media. This limited trial consists of 1 lecturer and 30 students. Before conducting the trial, students were given instructions on teaching materials using SPSS. At the time of the limited test implementation, the researcher explained what was contained in the teaching materials. This is done by researchers so that students are more enthusiastic when learning material on the teaching materials.

After the lecturers and students finished paying attention to the teaching materials, then on the last day of the trial, a questionnaire was given by the researcher. This questionnaire aims to see the extent to which lecturers and students respond to teaching materials using the SPSS software that has been developed. The results of the responses of lecturers and students to teaching materials using SPSS software show that teaching materials using SPSS software in terms of lecturer responses has an average of 4.14, while the results of data analysis of student responses to the implementation of learning were followed by 30 students at the limited trial stage. with the average percentage of student responses to the implementation of learning activities using SPSS software has a value greater than 80%. From all aspects that were asked, the average percentage of student responses was 83.27%.

Thus, the high percentage of students who gave positive responses proved that SPSS-based interactive teaching materials could be said to be effective. In addition, a questionnaire was also provided in the form of the implementation of SPSS-based interactive teaching materials which was filled in by subject lecturers, with the results as in the following table: Based on the table above, the results of the implementation of SPSS-based interactive teaching materials were obtained with an average of 80.43%, which is above 80%. the implementation of interactive teaching materials can be concluded practical to use.

3.5 Evaluation

Evaluation is the last stage of the ADDIE development model. Because in this study only limited trials, the evaluation referred to here is an evaluation of implementation activities. The results of the evaluation were obtained from suggestions from lecturers and students during the trial, so that from this evaluation stage a final revision was carried out.

4 Conclusion

The process of developing SPSS-based teaching materials using the ADDIE development model is carried out in 5 stages, starting from the Analysis, Design, Development, Implementation, to Evaluation stages. At the evaluation stage, there are 3 criteria for whether the material is feasible or not before it is used, namely valid, effective, and practical. Valid, the results of the validation of material experts with an average of 3.26 are in the very valid category, because 3 ≤ M ≤ 4, so the material in the media is said to be very valid, while the results of the validation of media experts with an average of 3.18 are in the very valid category, because 3 ≤ M ≤ 4, so this teaching materials is said to be very valid. Effective, this is said to be effective because the teaching materials is rated by students with an average percentage of positive responses of 83.27%. Practical, it is said to be practical because the percentage of teaching materials implementation is 80.43%.

References

PAKARNA (Papan Angka Berwarna) in Arithmetic Series Material

Rahayu Kariadinata¹, Juariah², Anis Niswatul Maula³
{rahayu.kariadinata@uinsgd.ac.id¹, anisniswatul28@gmail.com³}

Mathematics Education Department, UIN Sunan Gunung Djati Bandung, Bandung, Indonesia

Abstract. PAKARNA (Papan Angka Berwarna) is a learning medium used to see the basic concepts of arithmetic sequence material. PAKARNA learning media (Papan Angka Berwarna) is able to provide direct experience to students so that it is easy to understand the concept of arithmetic sequence material, besides that it is easy to use so that learning arithmetic sequences can be more effective and efficient, easy to manufacture, the learning media consists of several colors so as to attract the attention of students in learning mathematics. There are three aspects of accessing media experts, namely the content feasibility components, presentation components and graphic components of PAKARNA which are managed by media experts and mathematics teachers. The results obtained by the proportion of media validation for feasibility in total were 80%, that the PAKARNA media was feasible to be used as a classroom learning medium. Most (69%) students neglect positivity towards learning mathematics using PAKARNA learning media. This means that students are happy with learning using PAKARNA media.

Keywords: PAKARNA, Arithmetic Series, Learning Mathematics

1 Introduction

Nowadays, the rapid development of technology and science results in the ability and creativity of teachers in finding learning techniques that can stimulate students' understanding, talents and interests to be better and more diverse [1]. In learning, innovations are continuously carried out, one of which is through media that can be adapted to various existing methods. In the world of education today, there is a new paradigm in which learning makes the teacher as a companion and guide while students become the center of learning. Preliminary studies that have been conducted at SMP Muhammadiyah 10 Bandung show that students' mathematical communication skills are still not good. This was reinforced by the results of the students' mathematical communication skills test in the class with three description questions. The three items contain mathematical communication indicators [2]. These indicators include:

a. Provide answers by modeling concrete and algebraic problems.

b. Reflecting real objects and pictures into mathematical ideas.

c. Express mathematical concepts by expressing everyday events in mathematical language or symbols.
To maximize learning activities and to improve students' abilities in understanding the concepts of the material being studied so as to improve students' mathematical communication skills, learning media are used [3]. Media are various components that exist in the scope of learning that can help in the learning process. Learning media is one that can channel or convey messages from a source in a planned manner so that there is a process where the recipient can process it effectively and efficiently in a conducive learning environment.

In general, learning media has uses to clarify the learning material so that when the teacher explains it is not too verbal so that students understand more easily, can overcome the limitations of learning space and time in the school environment because in learning in school students must have predetermined competencies and can increase student learning motivation, make learning more interactive and provide learning experiences using the same learning media for all students [4].

From the opinion about the media, it is also known that the learning media functions as a learning tool as well as a learning aid. Learning media has a meaning that is almost the same as learning resources. Learning media can be used as a learning resource and vice versa learning resources can be used as a learning medium. Learning resources have a wider scope than learning media. Because not all learning sources can become learning media, while learning media is a medium for channeling messages.

One of the other media that can be used to develop mathematics learning media is to use PAKARNA (Papan Angka Berwarna). PAKARNA (Papan Angka Berwarna) is a learning medium used to find out the basic concepts of arithmetic sequence material. There are elements in the PAKARNA (Papan Angka Berwarna), namely a house shape board which is symbolized as a different value for each tribe, a box with flowers to symbolize each positive term, a plain box to represent each negative term, marbles are represented as the writing of the numbers for each term, the picture of a tree is symbolized to write down the value of each tribe and a number to write or represent the different values and terms on the house shape board and the picture of a tree.

PAKARNA learning media (Papan Angka Berwarna) is able to provide direct experience to students so that it is easy to understand the concept of arithmetic sequence material, besides that it is easy to use so that learning arithmetic sequences can be more effective and efficient, easy to manufacture, the learning media consists of several color so that it attracts the attention of students in learning mathematics, as well as cheap, because the learning media PAKARNA (Papan Angka Berwarna) uses wooden boards that are not too expensive, plastic boxes are widely used in the community, marbles are used to play by children, and number papers found in bookstores or grocery stores around the house.

Learning media are used by teachers so that learning can run effectively and efficiently and can help students more easily understand the material being studied. According to Komlasari [5] learning media is expected to provide benefits among other things:

a. Clarify the message so that it is not overly verbalistic.

b. Overcoming the limitations of space, time, energy, and sensory power.

c. Generating passion for learning, more direct interaction between students and learning resources.

d. Enable children to learn independently according to their visual, auditory and kinesthetic talents and abilities.

e. Giving the same stimulation, equalizing experiences and causing the same perception

The author seeks to develop learning media PAKARNA (Papan Angka Berwarna) is a learning medium designed to facilitate students in understanding the concept of arithmetic sequence material. The PAKARNA learning media (Papan Angka Berwarna) is made using a
board which is designed to have a house shape board which is used to write down the difference in the different values of each tribe, there are boxes with plain pictures and flowers. A box with a plain picture is represented as a negative term (-), a box with a flower is represented as a positive term (+), the box is used as a container for storing marbles where the marbles are represented as numbers. The tree image is used to write down how many tribes are in the flower and plain box. And there are numbers to represent or write different values and terms. The steps for using PAKARNA (Papan Angka Berwarna) are as follows:

a. Preparation before using the expert media
   At this stage, the teacher must prepare and ensure various things that can support the use of PAKARNA media so that they can be used when learning takes place. In addition, the teacher must also master the procedures for using the PAKARNA media. The things that must be prepared include:
   1) The teacher prepares the equipment and ensures that the PAKARNA media can be used when learning takes place.
   2) In the desert, studying the method of using expert because teacher must be able to explain to students the procedures for using PAKARNA.

b. Activities during the day using PAKARNA media
   At this stage, it must be able to condition students to remain orderly so that learning can run effectively and so that student concentration and interest in learning are maintained. At this stage the learning activity is to explain the concept of arithmetic sequences and sequences [6]. The steps for using PAKARNA media in this stage are as follows:
   The teacher prepares marbles for students.
   The teacher asks the students to put a few marbles into the boxes with the pictures of the first, second, third flowers and so on in PAKARNA. For example, students are asked to determine the number of marbles in the 5 boxes provided in PAKARNA. Students are asked to enter 2 marbles in the first box,

Fig. 1. PAKARNA Board

Make sure each box has a fixed difference from the squares that are close together, which is 2 marbles. Write down how many marbles are in each box with the flower picture into each
tree in PAKARNA. Because you enter 2 marbles in the first box, write the number 2 in the first tree image. Write down the difference between the marbles in the box with the first flower and the box with the second flower. Since the difference between the marbles in the first box and the second box is 2 marbles, then write the number 2 in the place prepared, namely in the first house image. Repeat the above steps from the next flower box on the tree image provided in the PAKARNA learning media [7].

From the results of the experiment above, it was found that each marble in the box formed a number pattern, namely 2, 4, 6, 8, and 10, then the teacher asked the students to add up the number patterns so that they obtained a value of 30. The teacher explained the basic concept of sequences and the arithmetic sequence, which is 2 marbles entered in the first box called the first term, 4 marbles in the second term, 6 marbles entered in the third term, 8 marbles entered in the fourth term box, and 10 marbles entered in the fourth term. entered in the fifth box is the fifth term. The difference in marbles from each adjacent box is 2 marbles or it can be called the difference \( b = 2 \), to determine the number of marbles in the third term can be obtained by adding the number of differences into the second term such as \( U_2 + b = U_3 \). Meanwhile, to determine the total number of marbles, it can be determined by adding up the number of marbles in the first term and the number of different marbles from the second term to the desired number of terms or it can be written with the formula \( S_n = \frac{n}{2} [2a + (n-1)b] \) [8]. Students are asked to observe and explain and re-practice what the teacher is modeling.

c. Follow up activities

This stage is the stage to find out whether the learning objectives have been achieved, and to strengthen understanding of the material that has been conveyed through the PAKARNA media and provide an evaluation of the learning outcomes. The steps are as follows:

The teacher provides practice questions to students regarding the learning material that has been given previously. The teacher repeats the lesson about understanding arithmetic sequences and series if there are still many errors in student learning outcomes using the median expert.

2 Method

This research uses the method of research and development (Research and Development). Research and development or Research and Development (R&D) is a process or steps to develop a new product, or to improve existing products, which can be accounted [9]. Products are meant not only in the form of objects such as books and modules, but can also be software such as computer programs for data management or classroom learning.

In this study, researchers used only 7 steps, namely: potential and problems, data collection, product design, design validation, design revision, product testing, and the final product because the research was conducted on a small scale. This is because in developing PAKARNA media, there are no product revisions, use trials and product revisions. The use trial stage is deemed unnecessary because it has been carried out at the product trial stage along with its revision.

![Fig. 2. Steps for Using the modified R&D method](image-url)
Based on Sugiyono's modified Research and Development (R&D) method [2], the steps to be taken in this study are:

1. Potentials and problems
   At the potential and problem stages, researchers conducted observations and interviews to find out the potential and problems. Researchers enter the classroom to observe the mathematics learning process, then interview the mathematics teacher to find out how the learning process is in class and how the attitudes of students in learning mathematics and how the level of students' mathematical communication skills. In addition to interviewing teachers, researchers also interviewed several students to find out how the students' opinions in learning mathematics and students' expectations in learning mathematics make learning more meaningful and enjoyable. Furthermore, the researcher carried out a preliminary test to find out the students' mathematical communication abilities then from the results of the preliminary study used as the basis for a background in developing learning media.

2. Data collection
   In the data collection stage, researchers collect data and information that can be used for product planning. Collecting data in this study is related to the results of observational data such as how the mathematics learning process is carried out, the results of interviews with teachers and students, and the results of the initial tests of students' communication skills and reviewing literature such as journals, SMP / MTs class 7 mathematics books.

3. Product design
   The next step is designing the PAKARNA media. PAKARNA media is made of plywood boards and made in such a way that there is a board that forms a house with storage boxes with plain pictures and flowers and trees. In addition, marbles or other objects that are used as numeric symbols are also needed in research. As well as numbers to write numbers on a house shape board and a picture of a tree.

4. Design validation
   Validasi design is an assessment based on rational thinking, before the facts in the field. The next step after the initial product is finished is consultation with a team of experts consisting of media experts and subject teachers.

Media PAKARNA is based on the rules adopted from Kariadinata. There are 3 aspects that are assessed, namely the components of the feasibility of the content, presentation and graphics of the PAKARNA which were then assessed by the experts and mathematics teachers at the Muhammadiyah 10 Bandung Department of Education, where the research was conducted.

5. Revised design
   After the 3 aspects assessed, namely the content feasibility component, presentation and product design graphics were validated by media experts and field teachers, suggestions and input were obtained. Then the suggestions and inputs are used to improve and produce better and more attractive products.
6. Testing the product

After the design revision was carried out, the PAKARNA media effectiveness test was carried out in learning. In this trial two classes were used, namely class VIII A and VIII B. The research approach used in this research is a quantitative approach with a quasi-experimental research method and the design used is the Nonequivalent control group design. In this method, the research class is divided into two categories, namely the experimental class and the control class. The experimental class and the control class were given a pretest to find out the initial abilities of students' mathematical communication abilities. Furthermore, in the experimental class, a learning process was carried out using PAKARNA media and a control class whose learning did not use PAKARNA media.

After carrying out the learning process, students are then given a final test (posttest) with the same test questions as the pre-test. Giving pretest and posttest is to determine the increase in students' mathematical communication skills after being given treatment.

<table>
<thead>
<tr>
<th>Table 1: Research Design PAKARNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretes</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>Experiment (PAKARNA media)</td>
</tr>
<tr>
<td>Control (Expository)</td>
</tr>
</tbody>
</table>

Information:
- X: Learning using media PAKARNA
- O: The questions tested for the experimental class and the control class

(Ruseffendi, 2005: 53)

To determine the feasibility of using the PAKARNA media, it was obtained from the results of the students' mathematical communication skills test, the results were obtained in the form of pretest and posttest scores. Then the obtained value is analyzed to obtain N-gain and a "t" test is carried out to determine the difference in student achievement in the experimental class and the control class. The scale of students' attitudes about the PAKARNA media after the lesson was carried out.

7. Final products

The final product of this research is the revised PAKARNA media which has been validated by experts and teachers, tested the feasibility of the product, and then can be used in mathematics learning with arithmetic sequence and series material at SMP Muhammadiyah 10 Bandung.

2.1 Types and sources of data

The types of data used in this research are quantitative and qualitative. Quantitative data is test result data in the form of numbers obtained from the pretest and posttest scores. Whereas qualitative data is data generated from observations of student and teacher activities and the scale score of students' attitudes towards the PAKARNA media.

Sampling in this study using probability sampling, namely simple random sampling. Two classes were selected from the entire population used in the study, namely class VIII B as the experimental class and class VIII A as the control class.

2.2 Instruments

The instruments used in this research are:
1. Expert validity checklist sheet
This instrument is used to assess the feasibility of media based on specific aspects of assessment as media validation that has been developed by experts for further use in the mathematics learning process in the classroom in improving mathematical communication skills. This instrument contains a checklist of content feasibility components, presentation components and graphic components for media experts [11].

2.2 Tes
The instrument used in this study was a test of mathematical communication skills in the form of descriptive questions and material lines and arithmetic series. The questions were given to students during the pretest and posttest, where the questions given were the same. The questions consist of two packages of questions about the type of A and B each of which has 5 items.

2.3 Non-test
The non-test instrument used was an attitude scale questionnaire. The questionnaire contained 3 indicators, namely students' attitudes towards mathematics learning, students' attitudes towards learning using PAKARNA media and students' attitudes towards mathematical communication skills [12].

This study used the Attitude Scale Model Likert with the priori method, namely the attitude scale model questionnaire calculated the score of each item according to the responses of the respondents. Each statement is completed with four answer choices: Strongly Agree (SS), Agree (S), Disagree (TS), and Strongly Disagree (STS).

The instrument that has been made is then analyzed. To analyze the research instrument, it is carried out as follows:

Instrument analysis technique
The instrument is in the form of an expert validity checklist sheet which is analyzed based on the eligibility rules of teaching materials according to BSNP for PAKARNA media which are based on the rules adopted from Kariadinata. The research data were then analyzed using the rating scale measurement scale determined by the following formula:

\[ p = \frac{\text{score from data collection}}{\text{ideal score}} \times 100\% \]

Description:

- **P** = percentage of product validity
- **Skor ideal** = highest score per item x number of respondent of item

The instrument in the form of tests of mathematical communication skills in the analysis includes validity, reliability, differentiation, and difficulty level.

a. Validity
Calculating the validity of the problem, the product-moment correlation formula is used using the following raw score:

\[ r_{xy} = \frac{N \sum XY - (\sum X)(\sum Y)}{\sqrt{(N \sum X^2 - (\sum X)^2)}(N \sum Y^2 - (\sum Y)^2)} \]

Information:

- **rxy** = coefficient of correlation between variable X and variable Y
- **X** = Score of each item
- **Y** = The total score of each student in the test
N = Number of female students
\[ \sum XY = \text{Sum multiplication XY} \]

b. Reliability
Calculating the reliability of the problem, then using the following Alpha formula:
\[ r_{11} = \left( \frac{n}{n-1} \right) \left( 1 - \frac{\sum S_i^2}{S_t^2} \right) \]

Information:
- \( r_{xy} \) = Test reliability coefficient
- \( n \) = Number of items excluded in the test
- \( \sum S_i^2 \) = The sum of the score variance per item
- \( S_t^2 \) = Variance of total score

c. Discernment
Calculating the distinguishing power using the following formula:
\[ DP = \frac{\bar{X}_A - \bar{X}_B}{SMI} \]

Information:
- \( DP \) = Distinguishing power
- \( \bar{X}_A \) = The average score of students in the upper group
- \( \bar{X}_B \) = The average score of students in the lower group
- \( SMI \) = maximum ideal score

d. Level of Difficulty
Calculating the difficulty level of each item, the following formula is used:
\[ IK = \frac{\bar{X}}{SMI} \]

Information:
- \( IK \) = difficulty index
- \( \bar{X} \) = The average score of the answers to each question
- \( SMI \) = maximum ideal score

2.4 Results of instrument analysis
The checklist sheet of the media feasibility instrument in the form of expert validity is given a judgment by an expert lecturer to find out that each indicator is fulfilled for the assessment of the feasibility of teaching materials according to BSNP for PAKARNA media. The assessment of the feasibility of the PAKARNA media has 3 indicators, namely components of the feasibility of content, presentation and graphics.

The assessment has been carried out on the expert validation checklist sheet to find out whether learning using PAKARNA media meets teaching materials.

2.5 Data collection techniques
The data used in the study of course must be collected first, the data collection techniques in this study can be seen in Table Data collection techniques
Table 2. Table Data collection techniques

<table>
<thead>
<tr>
<th>No</th>
<th>Data Sources</th>
<th>Aspect</th>
<th>Data Collection Techniques</th>
<th>Research Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Feasibility</td>
<td>Team for learning media</td>
<td>Assessment sheet</td>
<td>Rubric checklist</td>
</tr>
<tr>
<td></td>
<td>Expert</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Student</td>
<td>Students' mathematical communication skills</td>
<td>Pretest and posttest</td>
<td>Question sheet</td>
</tr>
<tr>
<td>3</td>
<td>Student</td>
<td>Assessment of attitudes towards learning, media and mathematical communication tests</td>
<td>Questionnaire</td>
<td>Attitude scale questionnaire</td>
</tr>
</tbody>
</table>

2.6 Data analysis technique

The data that has been collected is then analyzed by manual calculation. The data analysis techniques for each problem formulation are as follows.

1. The formulation of the first problems regarding the process of developing learning media was carried out with the modified Research and Development (R&D) method of Sugiyono, namely: Potential and Problems, data collection, product design, design validation, design revision, product testing, final products. Then analyzed with the rating scale measurement scale.

2. Whether the PAKARNA media is suitable for use is carried out by means of media feasibility validation analysis by experts and teachers. The data used is in the form of a media feasibility assessment sheet which consists of the feasibility components of the technician, presentation and graphic of the PAKARNA which is carried out by mathematics experts and teachers. Where in the assessment sheet there are various predetermined criteria then these criteria are assessed whether they fulfill the purpose of the items as described in the item predictions. The research data were then analyzed using the rating scale measurement scale determined by the following formula:

\[ p = \frac{\text{score from data collection}}{\text{Ideal score}} \times 100\% \]

Information:

- \( P \) = percentage of product validity
- Ideal score = highest score per number of respondent x number of items

3. Differences in the achievement of mathematical communication skills between students who use PAKARNA learning media and students who use expository learning. The answer to the formulation of the problem can be found by testing the difference between the means of the posttest results between the experimental class and the control class. Then if the results of the two averages are normally distributed, then proceed with the "t" test. However, if the results of the two-mean difference test
on the posttest results are not normally distributed, the homogeneity is not tested, but non-parametric statistics are used, namely by testing the Mann-Whitney. To perform the "t" test, the assumptions that must be fulfilled are that the data is normally distributed and homogeneous. If all assumptions have been fulfilled, then proceed with the "t" test.

4. Students' attitudes towards learning mathematics using PAKARNA media, so the data is analyzed quantitatively, that is, by looking at the average acquisition of attitude scores and the percentage of positive and negative attitudes. Furthermore, the average score of the students was compared with a neutral score. h The neutral score in this study is 2.50. The attitude scale categorization is:

- \( \bar{x} > 2.50 \): Positive
- \( \bar{x} = 2.50 \): Neutral
- \( \bar{x} < 2.50 \): Negative

Information:

\( \bar{x} \) = Average student score item

In addition to analyzing the average student scores, he also analyzed the percentage of positive attitudes and negative attitudes of each report. For positive statements, positive attitude is approval attitude (number of S and SS responses) and negative attitude is attitude of disapproval (number of TS and SSS responses). For negative statements, a positive attitude is an attitude of disapproval (the number of TS and STS responses) and a negative attitude is an attitude of approval (the number of responses from S and SS). To see the percentage of subjects who have positive responses to applied learning, it is calculated based on the Kuntjaraningrat criteria as follows:

\[
\text{Percentage of Answers} = \frac{\text{frequency of answers}}{\text{many respondents}} \times 100\%
\]

3 Results and Discussion

The research was conducted from 22 July 2020 to 31 August 2020. The research was conducted in 6 meetings. The first meeting for the pretest, four meetings for the learning, and the last fall meeting for the posttest. The material taught in this research is arithmetic sequences and series. The learning that is carried out is carried out online using the zoom meeting application for the control class due to the rules for learning at home and home visits for the experimental class.

![Fig. 1. Architecture Experiment Class](image1.png) ![Fig. 2. Control Class](image2.png)

a. PAKARNA media development description

PAKARNA learning media (Color Number Board) is a learning medium designed to make it easier for students to understand the concept of arithmetic sequence and series material. PAKARNA is made using a board designed in which there are several container boxes which can then be filled with marbles with the number of marbles according to the number of terms.
in the arithmetic sequence and sequence, where the marbles represent numbers. The container box in PAKARNA contains two groups of boxes marked using a plain image for negative arithmetic sequences and series and a flower-illustrated box used for positive arithmetic sequences and series.

In PAKARNA there are also tree pictures that can be used to show the number of marbles in the container box or show the number of terms. There is a house-shaped board that can be filled in with numbers indicating the difference in the number of marbles in the box or to show the difference between the tribes. And there are numbers to symbolize or show numbers on the house shape boards and tree images that are different values and tribes.

b. Description of the expert validity checklist sheet data

The feasibility of PAKARNA media is based on the rules of eligibility of teaching materials according to BSPN. There are 3 aspects assessed by media experts, namely the content feasibility component which has 11 items, the presentation component which has 2 items and the graphic component which has 3 items. The total items on the media expert validity checklist were 16 items. All these aspects were assessed by media experts from the Department of Mathematics Education, UIN Bandung and class VIII mathematics teachers of SMP Muhammadiyah 10 Bandung.

<table>
<thead>
<tr>
<th>No</th>
<th>Validator</th>
<th>Feasibility of Content (%)</th>
<th>Serving Components (%)</th>
<th>Graphic Components (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Media Expert (Prof. Dr. Hj. Rahayu Kariadinata, M.Pd.)</td>
<td>91%</td>
<td>88%</td>
<td>92%</td>
</tr>
<tr>
<td>2</td>
<td>Media Expert (Dra. Juariah, M.Pd.)</td>
<td>89%</td>
<td>88%</td>
<td>92%</td>
</tr>
<tr>
<td>3</td>
<td>Media Expert (Hamdan Sugilar, M.Pd.)</td>
<td>80%</td>
<td>63%</td>
<td>83%</td>
</tr>
<tr>
<td>4</td>
<td>Mathematics Teacher (Siti Rohmah Sakinah, S.Pd.)</td>
<td>61%</td>
<td>75%</td>
<td>67%</td>
</tr>
</tbody>
</table>

According to media expert Prof. Dr. Hj. Rahayu Kariadinata, M.Pd. based on the feasibility of the content obtained 91%, 88% presentation component and 92% graphic component. And get an overall score of 58 or if the percentage is 91% which if interpreted means that the PAKARNA media is very feasible to be used as learning media.

Media feasibility according to media expert Dra. Juariah, M.Pd. based on the feasibility of the content obtained 89%, 88% presentation component and 92% graphic component. And get an overall score of 57 or if the percentage is 89% which if interpreted means that the PAKARNA media is very feasible to be used as learning media.

Media feasibility according to media expert Hamdan Sugilar, M.Pd. based on the feasibility of the content obtained 80%, 63% presentation component and 83% graphic component. And get an overall score of 50 or if the percentage is 78% which if interpreted means that the PAKARNA media is suitable to be used as learning media but must be revised first.
Media feasibility according to media expert Siti Rohmah Sakinah, S.Pd. based on the feasibility of the content obtained 61%, 75% serving components and 67% graphic components. And get an overall score of 41 or if the percentage is 64% which if interpreted means that the PAKARNA media is suitable to be used as learning media but must be revised first.

c. Description of pretest data
The comparison of the increase in students’ mathematical communication skills can be seen from the results of the pretest and posttest. For more details regarding the control class pretest and experimental class pretest data.

![Control Class Pretest](image)

**Fig. 3. Control Class Pretest**

Based on Figure 3, it can be seen that the lowest score of the control class or class VIII A is 4.00 and the highest score is 13.00. It can be seen that the lowest score of the experimental class or class VIII B is 4.00 and the highest score is 12.00.

d. Posttest data description
The posttest was given to find out whether there was a difference after the students were treated with PAKARNA media.

![Eksperimen Class Pretest](image)

**Fig. 4. Experiment Class Pretest**
Based on Figure, it can be seen that the lowest score of the control class or class VIII A is 11.00 and the highest score is 17.00.

It can be seen that the lowest score of the experimental class or class VIII B is 13.00, the highest score is 19.00. The descriptive statistical results of pretest, posttest and N-Gain data.

<table>
<thead>
<tr>
<th>Score</th>
<th>Average</th>
<th>Standard Deviation</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Ideal Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>Experiment</td>
<td>8.18</td>
<td>2.02</td>
<td>12.00</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>8.58</td>
<td>1.94</td>
<td>13.00</td>
<td>4.00</td>
</tr>
<tr>
<td>Posttest</td>
<td>Experiment</td>
<td>16.25</td>
<td>1.51</td>
<td>19.00</td>
<td>13.00</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>15.15</td>
<td>1.41</td>
<td>17.00</td>
<td>11.00</td>
</tr>
<tr>
<td>N-Gain</td>
<td>Experiment</td>
<td>0.40</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>0.33</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>N-Gain</td>
<td>Experiment</td>
<td>Medium</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Interpretation</td>
<td>Control</td>
<td>Medium</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
e. Description of the n-gain data (pretest and posttest)
It can be seen that the highest N-gain obtained by the control class or class VIII A students is 0.60. Where as for the highest N-gain of the experimental class, the highest N-gain value is 0.70. The average N-gain value of the control class is 0.33, which is lower than the N-gain in the experimental class, which is 0.40.

f. Attitude scale data description
The attitude scale is given after giving treatment to the experimental group or class that gets learning with PAKARNA media for learning mathematics. It can be seen that the average student attitude towards learning mathematics is 2.96, the average student attitude towards learning mathematics using PAKARNA learning media is 2.75 and the average student attitude towards mathematical communication problems is 2.78. The three average values are greater than the neutral score of 2.50. PAKARNA media development in accordance with the stages of Research and Development (R&D), research and development or Research and Development (R&D) is a process or steps to develop a new product, or perfect an existing product, which can be held accountable. The product in question is not only in the form of objects such as books and modules, but can also be soft devices such as computer programs for data processing or classroom learning.

There are 3 aspects assessed by media experts, namely the content feasibility components, presentation components and graphic components of PAKARNA. The total items on the media expert validity checklist were 16 items. All these aspects were assessed by media experts, namely 3 lecturers in the Department of Mathematics Education, UIN Bandung and a class VIII mathematics teacher at SMP Muhammadiyah 10 Bandung.

The percentage of each aspect of the content aspect, presentation component and graphics can be seen in Table 5.

<table>
<thead>
<tr>
<th>Aspek Penilaian</th>
<th>Persentase (%)</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eligibility Content</td>
<td>80</td>
<td>Proper</td>
</tr>
<tr>
<td>Serving Components</td>
<td>78</td>
<td>Proper</td>
</tr>
<tr>
<td>Graphic Components</td>
<td>83</td>
<td>Very Proper</td>
</tr>
</tbody>
</table>

As for the percentage of media validation for the feasibility of the media as a whole is 80%, meaning that the PAKARNA media can be used as a learning medium with a feasible category. Based on the results of the calculation on the slip control, it is found that \(|F_T - F_S|\) largest < value of the Komogorov-Smirnov table = 0.12 < 0.26 so that \(H_0\) is accepted, meaning that the data is normally distributed. Based on the calculation results in the experimental class, it is found that \(|F_T - F_S|\) the largest < Komogorov-Smirnov table value = 0.17 < 0.25 so that \(H_0\) is accepted, meaning that the data is normally distributed. Furthermore, a test was carried out to determine the variance of the two data in the control class and experimental class, it was obtained that \(F_{count} < F = 1.15 < 1.94\) then \(H_0\) was accepted, that is, the two variances tested were homogeneous.

The "t" test for the N-gain score was calculated by the "t" test using Microsoft Excel. As for the formulation of the statistical hypothesis of the "t" test, the N-gain score is as follows:
H₀ : μ₁ = μ₂ : There is no difference in the achievement of mathematical communication skills between students who use PAKARNA (Papan Angka Berwarna) learning media and students using expository learning.

Hₐ : μ₁ ≠ μ₂ : There are differences in the achievement of mathematical communication skills between students who use PAKARNA (Papan Angka Berwarna) learning media and students who use expository learning.

Based on the results of calculations using a significant level of 0,05, it is found that t count (2.17) ≥ t table (2.01), so H₀ is rejected and Hₐ is accepted. So that there are differences in the achievement of mathematical communication skills between students who use PAKARNA learning media (Papan Angka Berwarna) and students who use expository learning.

Student responses to mathematics learning towards PAKARNA learning media are carried out a priori way. The attitude scale given is an attitude scale that has been consulted with the supervisor, namely an attitude scale which contains 25 questions. The student's attitude towards learning mathematics has a value of 2.96 while a neutral score is 2.50. So, students have a positive response to learning mathematics and seriously participate in the mathematics learning process. The student's attitude towards learning mathematics using PAKARNA learning media shows a score of 2.75, greater than a neutral score of 2.50. Students give positive responses to mathematics learning using PAKARNA learning media. Mean while, for students' attitudes towards mathematical communication questions, students also gave positive responses. It can be seen with the acquisition of a score of 2.78, which is greater than a neutral attitude, which is 2.50.

4 Conclusion

Based on the results of research conducted at SMP Muhammadiyah 10 Bandung with a population of all VIII students in the 2020/2021 academic year, by implementing learning using PAKARNA media to improve students' mathematical communication skills in arithmetic sequence material, in general, several things were drawn which became the following conclusions.

The process of developing PAKARNA learning media in each stage runs according to Sugiyono's modified Research and Development (R & D) stages which have been modified in 7 steps. These 7 stages are potential problems and problems, at this stage the researcher makes observations, interviews and conducts tests to find out students' initial abilities, the result is that students' mathematical communication skills are still lacking. The second is the collection of data related to the results of observation data, the results of interviews with teachers and students, and the results of students' mathematics communication skills and reviewing literature such as journals, mathematics books of SMP/MTs class VIII; Product design, namely designing PAKARNA media from various tools and materials that have been prepared; Design validation, media display, program and learning were then assessed by experts and mathematics teachers at SMP Muhammadiyah 10 Bandung, and the result was that there were things that had to be revised, namely in the way PAKARNA media worked.

Design revision, a design revision was carried out by adding a plastic container box which is used to distinguish negative arithmetic sequences; Product testing, this trial uses class VIII B and students are enthusiastic in using the PAKARNA media; Final products, PAKARNA media revised results that have been validated by experts and teachers, tested the feasibility of the product, and then can be used in mathematics learning with materials in line and arithmetic.
There are three aspects assessed by media experts, namely the content feasibility components, presentation components and graphic components from PAKARNA assessed by media experts and mathematics teachers. From this assessment, it was obtained that the percentage of media validation for the overall feasibility was 80%, that the PAKARNA media was feasible to be used as a classroom learning medium. There are differences in the achievement of mathematical communication abilities between students using PAKARNA learning media and students using expository learning. This can be seen from the differences in class achievement using PAKARNA media and expository classes. Most (69%) students have a positive attitude towards learning mathematics using PAKARNA learning media. This means that students are happy with learning using PAKARNA media.

References

Lanthanides MOFs (Samarium, Europium, and Terbium) Characteristics and Its Possible Potentials

Fahdunl Ashim¹, Agustino Zulys² and Jarnuzi Gunlazuardi³
{fahdunlashim@gmail.com¹, zulys@sci.ui.ac.id², jarnuzi@ui.ac.id³}

Department of Chemistry, Faculty of Mathematics and Natural Sciences, University of Indonesia, Depok, 16424, Indonesia

Abstract. The reaction between lanthanide nitrate (Sm, Eu, and Tb) with Na-PTC in DMF and water at 170 °C solvothermal for 6, 24, and 72 hours resulted in new Ln-MOFs which differed from one another. The new Ln-MOFs were then characterized using FTIR, UV-DRS, TGA, XRD, and SEM-EDX. FTIR and UV-DRS characterization showed that the synthesis time affected the Ln-MOF structure as seen from the FTIR spectrum shift and changed the band gap value. The three MOFs' XRD patterns showed a polycrystalline structure with about 20 nm with a crystallinity of less than 45% and not found in the X'Pert HighScore 2.1 and Match! 3 software database. This indicates that Ln-MOFs are new compounds. Ln-MOFs are not resistant to high temperatures based on the TGA characterization. The bandgap value for Ln-MOFs is 2.15 - 2.22 eV, so it has the potential as a photocatalyst to degrade dye and produce H₂ gas from the water in the visible area. The use of metal lanthanides allows MOFs to have potential as catalysts in organic reactions. However, this potential must be proven by further experiments.

Keywords: lanthanide nitrate, Ln-MOFs, solvothermal, photocatalyst, lanthanide metal

1 Introduction

Metal-Organic Frameworks (MOFs) was first synthesized in 1995 [1] and are still being developed to this day, both how to synthesize and use them. MOFs are porous materials composed of metal ions or cluster ions linked to organic compounds [2]. MOFs are also known as absorbent coordination polymers (PCPS), a new class of hybrid porous materials with a 3D crystal framework consisting of metal-oxo clusters and organic compounds as a linker [3]. Pores will form when the solvent is removed.

Metals that can make MOFs can be from alkaline earth, transition, and lanthanides [4]. Various organic compounds are used [5] depending on the intended use, physical properties, and desired chemical properties. However, the organic compound must have a functional group with a lone pair of electrons assigned to metal ions and can act as a bridge between metal ions, such as dicarboxylate groups, diamines, diimides, and others.

There are at least 11 methods to synthesize MOFs that have been developed by humans [6], such as solvo/hydrothermal synthesis [7], sonochemistry [8], slow diffusion [9], conventional heating [10], temperature-controlled cooling [11], gel growth crystallization technique [12], microwave synthesis [13], rapid precipitation procedure [14], electrochemical synthesis [6], modulation synthesis [15] and microfluidic synthesis [16]. Among the eleven
methods, making MOFs more often used is the solvothermal method because of its ease in synthesizing MOFs.

Applications from the use of MOFs to date that have been developed by humans are at least 7 \cite{17}. These MOFs include being used as gas storage (9), molecule separation (18), chemical catalysts \cite{2}\cite{15}, chemical sensors \cite{19–21}, ion exchange (22), drug delivery (23) and photocatalysts (24).

Lanthanide metals is an inner transition metal having 3d-4f orbitals. The presence of an f orbital in the lanthanide metals, which is still empty, can form a coordination number greater than or equal to 9 \cite{25}. The lanthanide metal can be made into MOFs and is known as Ln-MOFs \cite{2}. Ln-MOFs as the catalyst for oxidation and cyanoisilylation reactions \cite{2}, as a photocatalyst \cite{24}, as a chemical sensor \cite{7}\cite{21}\cite{26–30}, and for the degradation of dyes \cite{31}.

3,4,9,10-perylene tetracarboxylic acid (PTCA) is an organic compound that has four carboxylic acid groups. PTCA and its derivatives have several uses, such as materials for making organic solar cells \cite{32}, electro-oxidation of methanol \cite{33}, to detect Pb\textsuperscript{2+} \cite{34}, and oxidize water \cite{35}.

Based on the many MOFs, metal lanthanides, and PTCA applications, this research aims to synthesize MOFs using metal lanthanides and PTCA with the solvothermal method. The results of the characterization of Ln-MOFs were obtained as a consideration for the application of Ln-MOFs in the next research.

2 Experiment Section

2.1 Chemicals and Characterization Instruments

The chemicals used in this experiment were Sm(NO\textsubscript{3})\textsubscript{3}.6H\textsubscript{2}O, Eu(NO\textsubscript{3})\textsubscript{3}.xH\textsubscript{2}O, Tb(NO\textsubscript{3})\textsubscript{3}.5H\textsubscript{2}O (Sigma-Aldrich), NaOH (Merck), perylene 3,4,9,10-tetracarboxylic dihydrate (PTCDA) (Sigma-Aldrich), N, N dimethyl-formamide (DMF) (Merck), ethanol (Merck), methanol (Merck), and distilled water.

The synthesized Ln-MOFs were then characterized by Fourier Transform Infra-Red (FTIR) Prestige 21 Shimadzu, Diffuse Reflectance UV-Vis (Shimadzu spectrophotometer 2200A), Thermal Gravimetric Analysis (TGA), X-Ray Powder Diffraction (XRD) Spectrometer Shimadzu 6000 and Scanning Electron Microscope and Energy Dispersive X-ray Spectroscopy (SEM-EDX).

2.2 Synthesis of Na-PTC

The synthesis method of Na-PTC from PTCDA is the modified method from \cite{36}. The ligands to be used for the MOFs synthesis are in the form of salts, not acids. PTCDA (0.5 g, 1.27 mmol) was deposited in 50 ml of distilled water, then NaOH (0.356 g, 8.9 mmol) was added while stirring vigorously, and a solution of sodium perylene tetracarboxylic (Na-PTC) was formed, which was greenish-red. Then filtered and the filtrate obtained is added with excess ethanol to obtain a yellow precipitate. The Na-PTC precipitate was then filtered and washed by ethanol and dried at room temperature for 24 hours. Na-PTC and PTCDA were then compared to their IR spectrum using FTIR.
2.3 Synthesis of Ln-MOFs

The synthesis of Ln-MOFs is the modified method from [36]. Sm(NO\textsubscript{3})\textsubscript{3}.6H\textsubscript{2}O, Eu(NO\textsubscript{3})\textsubscript{3}.xH\textsubscript{2}O and Tb(NO\textsubscript{3})\textsubscript{3}.6H\textsubscript{2}O two mmol each (889.0; 676.0 and 870.0 mg) in different containers added with one mmol (516.3 mg) Na-PTC, 4 mL DMF and 11 mL distilled water. Then stirred for 45 minutes, then transferred to Teflon and autoclaved for 6, 24, and 72 hours at 170 °C. The crystals formed were filtered and then washed with distilled water and DMF. Then the crystals are dried in an oven at 60 - 80 °C for 24 hours.

3 Result and Discussion

3.1 Synthesis results of Na-PTC

The synthesis of Na-PTC ligands from PTCDA was successfully carried out, as evidenced by the ligands color before (red) and after (yellow). NaOH’s addition has a different color shown in Figure 1. Indicates that chemical bonds are missing or new bonds are formed. The formed or missing chemical bonds are proven by FTIR analysis, which can be seen in Section 3.3.

![Fig. 1. PTCA (red) and Na-PTC (yellow)](image)

NaOH reacts with an acid anhydride group ((RCO\textsubscript{2})O) to form RCOOH and RCOONa. The presence of excess NaOH in the solution makes NaOH react again with the RCOOH group formed in the first reaction. This made the entire (RCO\textsubscript{2})O group turn into RCOONa and was strengthened by the absence of an IR spectrum in the firm and vast area of 2,500 - 3,300 cm\textsuperscript{-1}, indicating the presence of the COOH group.

The purpose of converting PTCDA into Na-PTC (an acid anhydride compound into its salt) is because the solvent medium used to synthesize MOFs uses media containing water. At the same time, PTCDA is insoluble in water, so it needs to be converted into other compounds that are more soluble in water.

3.2 Synthesis results of Ln-MOFs

The synthesis of lanthanide MOFs (Ln-MOFs) was carried out by the solvothermal method at a temperature of 170 °C with DMF and water as a solvent. Using more than one type of solvent, the resulting MOFs are expected to be single crystals. The solvent used can
also be replaced according to the form of MOFs want to obtain, such as by using acetone, alcohol, acetonitrile, and others [37]. However, the variation of the solvent was not carried out in this research. The variation used was the length of the MOFs synthesis time with a temperature of 170 °C.

Before placing it in the ligand mixture oven, the metal salt and the solvent are yellow (Figure 2). The yellow color comes from the Na-PTC color, while the metal salts and solvents are colorless. After being put in the oven and drying, the mixture turns red even though the metal is different, as shown in Figure 3 and Figure 4, so it is assumed that Sm-MOFs, Eu-MOFs, and Tb-MOFs have almost the same shape. However, this assumption needs to be proven by further analysis, which can be seen in the section on characterization results with instruments.

3.3 FTIR characterization results

Based on the wavenumber value [38], the IR spectrum analysis on the ligands before and after reacting with NaOH (Figure 5) shows that new bonds are formed. Some are broken, such as initially there are C - O cyclic anhydride bonds (939 and 1,122 cm\(^{-1}\)) and C = O aromatic anhydride in the PTCDA structure (1,757 and 1,774 cm\(^{-1}\)) then becomes absent when Na-PTC compounds are formed and changes to C - O carboxylic acids (1,362 cm\(^{-1}\)) and C = O carboxylic anions (1,564 cm\(^{-1}\)). During the Na-PTC synthesis process, there was no -OH
group, which was proven by the absence of a healthy and board IR spectrum in 2,500 - 3,300 cm\(^{-1}\).

The IR spectrum region is divided into 2, namely the functional group area (3,600 - 1,250 cm\(^{-1}\)) and the fingerprint area (1,200 - 600 cm\(^{-1}\)) (38). Analysis of the IR spectrum in the functional group region of Ln-MOFs (Ln: Sm, Tb, and Eu) has the same functional group but with slightly different wavenumber values. In the fingerprint area (fingerprint), the IR spectrum has almost the same shape, but the intensity is different. This strengthens the temporary suspicion that the three MOFs have almost the same shape. The comparison of the IR spectrum of the ligands with Ln-MOFs can be seen in Figure 5.

![Spectrum IR](image)

**Fig. 5.** The comparison of the IR spectrum of the ligands with Ln-MOFs

Comparing the IR Sm-MOFs spectrum with the synthesis time of 6, 24, and 72 hours (Figure 6) shows almost the same spectrum shape but with different intensities. The intensity of the C = O bond in the area 1,710 - 1780 cm\(^{-1}\) has decreased. This shows that the synthesis time affects the structural shape of the MOFs. This is also experienced by [39] between 10 minutes and 1 hour reaction time at 95 °C and [40] synthesized MOFs for 24 hours and 48 hours at 150 °C to produce different forms of MOFs.
Fig. 6. Comparison of the IR spectrum to the difference in the length of time to synthesize Ln-MOFs

3.4 UV-DRS characterization results

The data obtained from UV-DRS is only in the form of wavelength (λ) and percent reflectance (% R), so it needs to be processed first by using the Kubelka-Munk function (equations 1 - 5) to estimate the band gap value of MOFs. The bandgap value is obtained by plotting the x-axis $h\nu$ and the y-axis $(F(R)h\nu)^2$ with Origin 2017 64-bit software, and the calculation of the Ln-MOFs band gap value can be seen in Table 1.

$$h\nu = \frac{1240}{\lambda}$$  \hspace{1cm}  (1)

$$F(R) = \frac{K}{S}$$  \hspace{1cm}  (2)

$$K = (1-R)^2$$  \hspace{1cm}  (3)

$$S = 2R$$  \hspace{1cm}  (4)

$$R = \frac{\%R}{100}$$  \hspace{1cm}  (5)
Information:
h.ν: Energy (eV)
λ: Wavelength (nm)
F (R): Kubelka-Munk Function
K: Molar absorbance coefficient
S: Scattering factor
R: The reflectance of the material
% R: Percent reflectance of the material

<table>
<thead>
<tr>
<th>MOFs</th>
<th>Synthesis Time (hours)</th>
<th>Eg₁ (eV)</th>
<th>Eg₂ (eV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sm-MOFs</td>
<td>6</td>
<td>2.09</td>
<td>2.02</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>2.08</td>
<td>2.16</td>
</tr>
<tr>
<td></td>
<td>72</td>
<td>2.00</td>
<td>2.15</td>
</tr>
<tr>
<td>Eu-MOFs</td>
<td>24</td>
<td>2.10</td>
<td>2.18</td>
</tr>
<tr>
<td></td>
<td>72</td>
<td>1.93</td>
<td>2.15</td>
</tr>
<tr>
<td>Tb-MOFs</td>
<td>24</td>
<td>2.09</td>
<td>2.22</td>
</tr>
<tr>
<td></td>
<td>72</td>
<td>1.97</td>
<td>2.19</td>
</tr>
</tbody>
</table>

Based on the data obtained, Ln-MOFs have 2 Eg (Eg₁ and Eg₂). This is because the UV-DRS spectrum has two peaks that indicate that there is not only one electronic transition. The Eg₁ value in Ln-MOFs tends to decrease with increasing synthesis time. The Eg₂ value in Sm-MOFs had increased from 6 hours to 24 hours of synthesis time and then decreased at 72 hours of synthesis time. This reinforces the notion that the length of time for synthesis will affect the structural shape of MOFs.

Ln-MOFs showed a bandgap value greater than 1.23 eV, so that Ln-MOFs has potential as a photocatalyst for water splitting. However, it is necessary to carry out cyclic voltammetry (CV) analysis and the application of photocatalytic water to strengthen the suspicion that the water-splitting reaction can work or not.

Based on the FTIR analysis results and the bandgap values that were not much difference between the synthesis time of 6, 24, and 72 hours, then for further analysis using Ln-MOFs with a synthesis time of 72 hours.

3.5 TGA characterization results

TGA analysis on Sm-MOFs and Tb-MOFs for 72 hours was carried out at a temperature of 25 - 550 °C. The results obtained are not much different, which can be seen in Figure 7. As the TGA analyzer temperature continues to increase, the MOFs’ weight continues to decrease from a temperature of 25 °C to 200 °C. Sm-MOFs fell by 3.57%, while Tb-MOFs was 4.76%. This shows that MOFs are not resistant to high temperatures.
When the TGA analyzer temperature was above 225 °C to 500 °C, the MOFs’ weight was almost half (41.72% and 41.64%). This shows that the organic compounds from MOFs have begun to degrade. After the TGA analysis process is complete, the MOFs’ color, which initially was red, turned gray (Sm-MOFs) and brown (Tb-MOFs), as shown in Figure 8. Gray and brown colors indicate that metal oxide has formed. Ln-MOFs that have begun to degrade at high temperatures are still suitable if used as photocatalysts to produce H₂ gas from the water with visible light.

Then based on the results of FTIR and UV-DRS analysis, which were not much different between Sm-MOFs, Eu-MOFs, and Tb-MOFs, then the Eu-MOFs were suspected if the TGA analysis was carried out, the results were not much different.

**3.6 XRD characterization results**

Peaks XRD on Sm-MOFs, Eu-MOFs, and Tb-MOFs with a synthesis time of 72 hours can be seen in Figure 9. Based on the XRD peaks, the Ln-MOFs synthesized are still polycrystalline. The XRD peaks on Ln-MOFs had the best images of Sm-MOFs 72 hours and had a higher intensity compared to Eu-MOFs and Tb-MOFs with the same synthesis time of 72 hours.
The XRD peaks pattern from Ln-MOFs was also tried to find using X’Pert HighScore 2.1 and Match! 3 software, but not found in the software database. This shows that Ln-MOFs are new compounds.

Based on the XRD peaks, we can estimate three things: the degree of crystallinity, the crystal size, and the distance between the crystal planes. The peaks are further processed using Origin 2017 64 bit software and Microsoft Excel.

Sm-MOFs 72 hours, Eu-MOFs 72 hours, and Tb-MOFs 72 hours each have a crystallinity of are 23.14%, 30.69%, and 41.07%. The Ln-MOFs crystal size can be estimated using the Scherrer equation, which is equation 6. Mathematically, the mean crystal size was 24.97 nm (Sm-MOFs 72 hours), 18.99 nm (Eu-MOFs 72 hours), and 22.80 nm (Tb-MOFs 72 hours). The complete mathematical crystal size data can be seen in Table 2. Bragg's law estimated the distance between the crystal planes (equation 7) so that the results can be seen in Table 2.

\[
D = \frac{K\lambda}{\beta \cos \theta}
\]  
\[d = \frac{\pi \lambda}{2 \sin \theta}
\]
Information:

\( \lambda \): Wavelength of X-rays (1,5406 Å)

\( \theta \): Peak position (rad)

\( n \): Diffraction order (n = 1)

\( d \): The distance between 2 crystal planes/d-spacing (Å)

### Table 2. Crystal Size and d-spacing Ln-MOFs

<table>
<thead>
<tr>
<th></th>
<th>Sm-MOFs 72 Hours</th>
<th>Eu-MOFs 72 Hours</th>
<th>Tb-MOFs 72 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak position 2θ (°)</td>
<td>Crystal size (nm)</td>
<td>d-spacing (Å)</td>
<td>Peak position 2θ (°)</td>
</tr>
<tr>
<td>1</td>
<td>6.27</td>
<td>22.62</td>
<td>14,090</td>
</tr>
<tr>
<td>2</td>
<td>11.76</td>
<td>23.70</td>
<td>7,518</td>
</tr>
<tr>
<td>3</td>
<td>16.79</td>
<td>24.68</td>
<td>5,277</td>
</tr>
<tr>
<td>4</td>
<td>18.86</td>
<td>25.72</td>
<td>4,777</td>
</tr>
<tr>
<td>5</td>
<td>20.94</td>
<td>27.56</td>
<td>4,239</td>
</tr>
<tr>
<td>6</td>
<td>27.77</td>
<td>25.53</td>
<td>3,210</td>
</tr>
<tr>
<td>7</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### 3.7 SEM-EDX characterization results

SEM-EDX analysis on Ln-MOFs shows that the MOFs’ shape is still varied, with magnifications of 10,000x, 25,000x, and 50,000x. This is under the results of XRD characterization, which still shows a polycrystalline form. Ln-MOFs at 25,000x magnification have a gravel-like shape, as can be seen in Figure 10.
The lanthanide group elements are already present in Ln-MOFs. The elements of carbon and oxygen were also detected. This element comes from the ligands used. Other elements detected with small intensity come from impurities in the SEM-EDX instrument. The element intensity detected in Ln-MOFs can be seen in Figure 11.

![EDX analysis for Ln-MOFs]

**Fig. 11.** EDX analysis results from Ln-MOFs

### 3.8 Potential applications of Ln-MOFs

Based on the three Ln-MOFs characterization results, Ln-MOFs have the potential as a photocatalyst to produce H₂ gas from water and degrade dye. MOFs can act as photocatalysts,
and it can be seen from the band gap value. If the bandgap value is more significant than 3.1 eV, it is irradiated with UV light, and if it is less than 3.1 eV, visible light can be used \([41]\). The potential of Ln-MOFs in this research as a photocatalyst to produce \(\text{H}_2\) gas from water and degrade dye can be seen in Table 3 and Table 4.

The presence of \(d\) and \(f\) orbitals causes complex compounds of lanthanides to function as Lewis acids to be used as catalysts in the Fridel – Crafts, Diels – Alder, aldol, allylation, and Michael addition reactions \([2]\). The synthesis reaction of organic compounds with the help of Ln-MOFs can be carried out at room temperature up to 80 °C \([42]\). Based on these, the three new Ln-MOFs that were successfully synthesized have potential as catalysts in organic compounds. However, this potential must be tried experimentally first.

### Table 3. MOFs research as a photocatalyst to produce \(\text{H}_2\) gas from water

<table>
<thead>
<tr>
<th>MOFs</th>
<th>Band Gap (eV)</th>
<th>Photosensitizers</th>
<th>Sacrificial agents</th>
<th>Cocatalysts</th>
<th>Irradiation</th>
<th>(\text{H}_2) Production rate ((\mu\text{mol} \cdot \text{g}^{-1} \cdot \text{h}^{-1}))</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCN-415-NH(_2)</td>
<td>1.99</td>
<td>-</td>
<td>TEOA</td>
<td>Pt</td>
<td>Visible</td>
<td>594</td>
<td>[43]</td>
</tr>
<tr>
<td>Cu-I-bpy</td>
<td>2.05</td>
<td>-</td>
<td>TEA</td>
<td>-</td>
<td>UV</td>
<td>7.09</td>
<td>[44]</td>
</tr>
<tr>
<td>MOF-199/Ni</td>
<td>2.48</td>
<td>Eosin Y</td>
<td>TEOA</td>
<td>-</td>
<td>Visible</td>
<td>8000</td>
<td>[45]</td>
</tr>
<tr>
<td>{[Tb(_2)Cu(_5)(OH)(_2)(_2)(pyd(_3))(H(_2)O)(_8)](_8)}(_8)}   (\text{I}_8)</td>
<td>2.82</td>
<td>MeOH</td>
<td>-</td>
<td>-</td>
<td>UV</td>
<td>2105.0</td>
<td>[24]</td>
</tr>
<tr>
<td>Ln-MOFs ((\text{Ln: Sm, Eu and Tb}))</td>
<td>1.93 – 2.22</td>
<td>Na-PTC</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

### Table 4. MOFs research as a photocatalyst degradation of dyes

<table>
<thead>
<tr>
<th>MOFs</th>
<th>Band Gap (eV)</th>
<th>Dye</th>
<th>Irradiation</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>BR14@HKUST-1</td>
<td>-</td>
<td>RB13</td>
<td>Visible</td>
<td>[46]</td>
</tr>
<tr>
<td>MIL-53(Fe)</td>
<td>-</td>
<td>RhB</td>
<td>Visible</td>
<td>[47]</td>
</tr>
<tr>
<td>MIL-53(Al)</td>
<td>3.87</td>
<td>MB</td>
<td>Visible</td>
<td>[48]</td>
</tr>
<tr>
<td>MIL-53(Cr)</td>
<td>3.20</td>
<td>MB</td>
<td>Visible</td>
<td>[48]</td>
</tr>
<tr>
<td>MIL-53(Cr)</td>
<td>2.72</td>
<td>MB</td>
<td>Visible</td>
<td>[48]</td>
</tr>
<tr>
<td>Ln-MOFs ((\text{Ln: Sm, Eu, and Tb}))</td>
<td>1.93 – 2.22</td>
<td>-</td>
<td>-</td>
<td>This Research</td>
</tr>
</tbody>
</table>

### 4 Conclusions

A total of 3 new Ln-MOFs were successfully synthesized. The Ln-MOFs have almost the same functional groups and band gap values but are still polycrystals with the largest crystal size owned by Sm-MOFs, then Tb-MOFs, and Eu-MOFs. The newly synthesized Ln-MOFs have the potential as photocatalysts to produce \(\text{H}_2\) gas from water; photocatalysts degrade dyes and catalysts in the synthesis of organic compounds.
Acknowledgments

The author is grateful for the funding support for this research from the Directorate of Research and Development (Risbang), the University of Indonesia, from the UI Research Grant (Hibah Riset UI) 2020 and confirms that there is no conflict of interest were declared regarding this research.

References


Bacteriological Test of Food Equipment in Basic School Canteen Working Area UPTD Puskesmas Mabelopura

Finta amalinda¹, Novi susanti², Miswan³, Nur afni⁴, Arief mulliawan⁵, Agus halid⁶ {finta274866@gmail.com¹, novisusanti051187@gmail.com², miswan.wanling@gmail.com³}

Department of Public Health, Universitas Muhammadiyah Palu, 94118 Indonesia¹,²,⁴, Department of Mathematics and science, Universitas Tadulako, 94118 Indonesia³,⁵,⁶

Abstract. This study aims to test the bacteriology of food utensils in the elementary school canteen of the UPTD Puskesmas Mabelopura. The research object is tableware. Bacterial samples on cutlery were taken using the swab method (wiping the surface of the cutlery) then the samples were taken to the laboratory to be tested. 8 cutlery samples were taken from 8 canteens in elementary schools in the working area of the UPTD Puskesmas Mabelopura. The laboratory test results identified the number of germs on the examined tableware, namely, plate 22 CFU/cm², 39 CFU/cm², 23 CFU /cm², spoon 1,513 CFU/cm², 939 CFU/cm², glass 2,217 CFU/cm², 251 CFU/cm², bowl 1,727 CFU/cm². Which indicates that the equipment in the canteen does not meet the eligibility requirements for tableware, because based on Permenkes RI No. 1096/Menkes/Per/VI/2011 regarding the requirements for tableware used, especially by traders, that it should not contain bacterial colonies or 0 colonies/cm² surface.

Keywords: Bacteri, Cutlery, Diarrhea, school canteen

1 Introduction

The morbidity and mortality rates in Indonesia due to diarrhea are still high [1]. Approximately 760,000 children die each year due to diarrheal disease which is the second leading cause of child mortality. Diarrhea that lasts for several days causes severe dehydration and loss of excess body fluids. Diarrhea is caused by contamination of food and water sources, it can also be caused by eating utensils that do not meet health standards [2].

Street food can be found in almost every school, especially elementary schools. This place to sell food is called a canteen. The canteen usually provides the food needs of school residents. The school canteen is managed by canteen officers. The operation of the canteen must follow procedures on how to process and maintain the cleanliness of the canteen. The types of food provided must also meet at least 4 healthy and 5 perfect [3].

Based on Law Number 7 of 1996 concerning food, it states that the quality of food consumed must meet several criteria, including being safe from biological, microbiological, chemical, heavy metal, and other contaminants that can endanger health [4]. Apart from food quality, it is also important to pay attention to the health of food and beverages so that there is
no contamination of the growth of germs and additives that come from the food handling process served by traders. Factors that need to be considered in food processing are the quality of the equipment used in processing food ingredients, as well as those used to serve to consumers [5].

Food utensils, play an important role in the spread of disease. Unclean eating utensils can contain bacteria, as a result, bacteria entering the body can cause poisoning and even death if a person does not have a strong immune system [6]. Cleaning good cutlery will minimize or prevent bacterial contamination of tableware. This requirement must be known and implemented by food processors or traders and handlers [7].

The World Health Organization (WHO) estimates that 1 in 10 people suffer from congenital diseases and 420,000 people die every year as a result. Foodborne diseases that exist in various industrialized countries today indicate that 60% of cases are caused by poor food handling techniques, and contamination occurs when served in food processing facilities (TPM). The role of sanitation is very important in an effort to prevent the possible growth and development of rotting microbes and pathogens in food, beverages, equipment, and buildings that can damage food and endanger humans [8].

In Indonesia, foodborne illness is still a public health problem due to frequent reports of food poisoning in many areas. From January to March 2016, there were 31 incidents of food poisoning (30 food, 1 drink). 12 consecutive foods-induced poisoning incidents of food poisoning with 354 victims 2 of them died, food poisoning with a total of 190 people with 1 death, processed food in packs of 3 incidents of poisoning with 120 victims, and 1 incident of poisoning due to adulterated liquor with a total of 42 victims with 24 victims died [8].

In Central Sulawesi Province, in 2018 there were 3 outbreaks of food poisoning with 102 cases without any deaths. There was a decrease in the frequency of incidents compared to the Food Poisoning Outbreak in 2017 with 7 incidents with 354 cases without any death cases [9]. And in 2019 the overall Food Poisoning Outbreak occurred as much as 170 cases without death. Occurred in 5 districts / cities with the highest number in Parimo Regency with 72 cases, Palu City 55 cases with 2 times the frequency of incidents in different Puskesmas work areas, Buol District 17 cases, in Tolitoli Regency 2 times the frequency of food poisoning outbreaks with 16 cases and District Poso as many as 10 cases [10].

Mabelopura Puskesmas is one of the Puskesmas in Palu City. In the work area of the UPTD Puskesmas Mabelopura, there are 8 primary schools located in 2 urban villages, Tatura Utara and Tatura Selatan villages. Based on the preliminary observations made, it can be seen a picture of street food in the school canteen with a lot of visitors in one of the canteens, snack food in the form of yellow rice, fried rice, and syrup drinks. So that the use of cutlery in the form of plates, spoons, bowls, and glasses that are widely used by students. And seeing the conditions of the canteen which do not meet the requirements for the tableware washing technique, because it does not use water that flows from the tap, only uses tamping water in a bucket container.

Based on this description, the researchers are interested in conducting a bacteriological test on the food equipment for the elementary school canteen in the UPTD Puskesmas Mabelopura working area.
2 Research Method

2.1 Flow of research concept framework

The flow of the research concept framework can be seen as follows:

Fig. 1 Flow of concept outline

2.2 Research sites

Samples were taken from eight elementary school canteens whose locations are still in the work area of the UPTD Mabelopura Health Center in 2020. As for the testing, it was carried out in the Laboratory of the Poltekkes Palu Environmental Health Department.

2.3 Research time

This research was conducted in February 2020.

2.4 Object of research

The object of this research is tableware in the State Elementary School Canteen in the working area of the UPTD Puskesmas Mabelopura.

2.5 Research procedure

Several procedures were carried out in this study, namely:

2.5.1. Sampling technique

1. Prepare equipment and materials to be used
2. wear sterile gloves at the time of sampling
3. The cutlery to be checked is 4-5 each type of cutlery taken randomly from the storage area.

4. Prepare a sterile cotton swab, open the bottle cap and insert a sterile cotton stick into it.

5. The cotton stick in the bottle is pressed against the wall of the bottle, then removed and rubbed on each cutlery (plate, spoon, bowl, glass).

6. The surface where the appliance/furniture is rubbed, namely:
   - Plates: the inner surface on which food is placed
   - Spoon: the outer and inner surfaces of the entire spoon bowl
   - Bowl: the surface in which food is placed
   - Glass: outer and inner surface of the lip as high as 6 mm

2.5.2. How to do the swab/swab technique:

1. With plates and bowls with two strokes on the surface of the food container with a square crossing between one stroke and the second stroke line.

2. On the spoon wipe the entire outer and inner surface.

3. On a glass with strokes around the surface area.

4. Each surface area that was wiped was carried out 3 times in succession, and 1 cotton stick was used for one group of cutlery that was examined.

5. Each result of rubbing one cutlery from one group was put into a bottle of liquid which was rotated and pressed against the wall, then repeated until all groups were taken.

6. After all the cutlery groups or the surface area of the cutlery are wiped, the cotton stick is put into the bottle, the lid is broken or cut, and the bottle's lip is heated with a spits fire, then covered with cotton.

7. The sample is labeled with a collotype attached, the label contains information about: the place for taking the sample, the name of the sample/tool, and is given a number/code.

8. The sample is immediately taken to the laboratory under cold temperature for examination.

2.5.3. How sample inspection works:

1. Prepare 4 media of diluting distilled water, then coded according to dilution 10^{-1}, 10^{-2}, 10^{-3}, and control.

2. Taking samples of equipment in PBS media, shaking until homogeneous, sterile pipette 1 ml poured in a 10^{-1} dilution, then shaken.

3. From a 10^{-1} dilution, pipette back 1 ml and pour in a 10^{-2} dilution.

4. From a 10^{-2} dilution, another 1 ml pipette was poured in a 10^{-3} dilution.

5. For the control pipette 1 ml of sterile distilled water is poured into a petridisk dish.

6. Sterile petridisk plate container, provide dilution and control code.

7. Pipette 1 ml from planting and 10^{-3} dilution, and pour in a petri dish labeled 10^{-3}, then pipette 1 ml from planting at a 10^{-2} dilution, and pour into a petridish coded 10^{-2}, and pipette 1 ml from planting at a 10^{-1} dilution, and pour in a petridish that is coded 10^{-1}.

8. After that, pour the PCA media on everything with warm 15-20 ml, while shaking it slowly until homogeneous.

9. Pour until frozen, wrap with aluminum foil paper.

10. Put in the best position incubator, incubate at 37°C for 2x24 hours.

11. Read the colonies that grow with the colony counter, note the number of colonies.
3. Result and Discussion
3.1 Research Location Overview

UPTD Puskesmas Mabelopura is one of the Puskesmas in Palu City which is located at the street I Gusti Ngurah Rai No. 18 South Palu District, Palu City, Central Sulawesi Province. Mabelopura Puskesmas has 2 (two) working areas, namely North Tatura Village and South Tatura Village. As the technical implementing unit of the Palu City Health Office, the UPTD Puskesmas Mabelopura is responsible for organizing health development in its working area.

The canteen is a place that provides food and is in an elementary school environment. In the Mabelopura Puskesmas working area, there are 8 elementary schools. Each elementary school has 1 canteen. The description of the condition of the canteen in the primary school in the working area of the Mabelopura Community Health Center, namely; the location of the equipment washing place is not neat and cleanly arranged, the distance between the washing and the equipment rack is still very close. Equipment rack made of wood and not covered with plastic. The process of washing equipment that does not use running water, only by means of a container / tub, thus drying tableware using a damp cloth or napkin.

3.2 Research result

The study was started on February 1, 2020. By taking samples of bacteria on tableware in the canteen of the Primary School in the UPTD Puskesmas Mabelopura Work Area. Bacterial samples on tableware were examined at the Laboratory of the Environmental Health, Department of the Health Polytechnic of the Ministry of Health, Palu. The results obtained are as follows:

<table>
<thead>
<tr>
<th>No</th>
<th>Location</th>
<th>Sample Name</th>
<th>Check up result</th>
<th>CFU / CM² Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SDN 3 Inpres Tatura</td>
<td>Spoon</td>
<td>1513</td>
<td>0 CFU/cm²</td>
</tr>
<tr>
<td>2</td>
<td>SDN 2 Tatura</td>
<td>Plate</td>
<td>22</td>
<td>0 CFU/cm²</td>
</tr>
<tr>
<td>3</td>
<td>SDN 1 Tatura</td>
<td>Plate</td>
<td>39</td>
<td>0 CFU/cm²</td>
</tr>
<tr>
<td>4</td>
<td>SD Bala Keselamatan Palu</td>
<td>Glass</td>
<td>2.217</td>
<td>0 CFU/cm²</td>
</tr>
<tr>
<td>5</td>
<td>SDN Inpres 1 Tatura</td>
<td>Bowl</td>
<td>1.727</td>
<td>0 CFU/cm²</td>
</tr>
<tr>
<td>6</td>
<td>SDN 2 Anoa</td>
<td>Glass</td>
<td>251</td>
<td>0 CFU/cm²</td>
</tr>
<tr>
<td>7</td>
<td>MIS Al- Jufri</td>
<td>Spoon</td>
<td>939</td>
<td>0 CFU/cm²</td>
</tr>
<tr>
<td>8</td>
<td>SDN Darusalam</td>
<td>Plate</td>
<td>23</td>
<td>0 CFU/cm²</td>
</tr>
</tbody>
</table>
Based on table 1 above, it can be seen that the results of laboratory tests on the number of germs there are bacteriology on the tableware that are examined, namely, plates, spoons, bowls and glasses are carried out using the total plate count method, each calculated depending on the surface area of the sample being swabbed. From the results above, the sample examined shows that it does not meet the health requirements according to the Regulation of the Minister of Health of the Republic of Indonesia 1096 / Menkes / SK / VI / 2011 concerning the requirements for food sanitation sanitation, where the number of germs on tableware is equal to 0 (zero).

3.3 Discussion

The role of tableware used by food traders is an inseparable part of the principles of food hygiene. Every utensil (plate, glass, spoon) must be kept clean at all times. Cutlery that looks clean is not a guarantee that health requirements are fulfilled. For this reason, it is very important to know the basics of washing equipment, with good washing will produce clean and healthy equipment. Keeping tableware clean has helped prevent contamination or contamination of the food consumed [11]

Canteen sanitation has requirements that must be met, among others, with regard to sanitation facilities. Includes clean water, washing equipment. Cleanliness of cutlery is a very important part and affects the quality of food and beverages. Bacterial contamination can occur on cutlery. Lack of cleanliness of cutlery plays an important role in the growth and spread of bacteria [12]. Improper washing process by leaving food/oil and a number of germs on the surface of eating and drinking utensils. Leftover food / oil is a medium for bacteria and fungi to reproduce, while residual germs from the mouth/hands of consumers can be a source of infection for other consumers. Several pathogens identified in the oral cavity / saliva include Mycobacterium tuberculosis, Bacillus sp., S. Aureus, S. Epidermidis, E. coli, Haemophilus influenzae, herpes simplex viruses, hepatitis C virus, HIV, SARS-CoV-1, and SARS-CoV-2 [13]. In this study, taken as a sample, food utensils in the form of plates, spoons, glasses and bowls, where the cutlery is mostly used to serve snacks to students. Based on the research results obtained:

1. Tableware in the canteen of SD 2 Tatura 22 CFU / cm², SD 1 Tatura 39 CFU / cm², SD Darusalam 23 CFU / cm². None of the sample tests met, the equipment requirements. The shape of the plate is wide and easy to scrub with a washing sponge so that it is not done properly. When there are still dry food residues and no attention is paid to cleaning it will be a good medium for bacteria to grow. Likewise, the primary school canteen only uses a sink for washing water, and does not soak dirty cutlery, but is immediately washed, rinsed and in a cloth that is used repeatedly during the drying stage.

2. Spoon food utensils in the canteen of SD 3 Impres Tatura examination test results are 1,513 CFU / cm², and spoons in the canteen of SD MIS Al-Jufri 939 CFU / cm². None of the sample tests met, the equipment requirements. The high total number of microbes in the spoon is influenced by several factors, including the handlers who wash the equipment, only dipping or putting the spoon into a water bath then rubbing it with a cloth and draining it. Washing cutlery that does not use running water and drying with a dirty cloth increases the number of germs.

3. Glass food utensils in the canteen of SD Bala Keselamatan examination test result are 2,217 CFU / cm², and glasses in the canteen of SD 2 Anoa with the results of the examination test results of 251 CFU / cm². None of the sample tests met, the
equipment requirements. This is because the shape of the glass which is difficult to reach in the deepest gap results in washing and rubbing only on the lip of the glass, this has the risk of growing bacteria that settle in the basic cracks, tends to be difficult to wash and wipe to dry because of the narrow shape of the glass inside. The risk of contamination if the place to put the glass is not in a clean condition. From observations in the canteen, it can be seen that the washing method does not use disinfectants and the washing tub water that is not replaced after being used several times. In addition, this is because the source of clean water is far from the canteen, so that flowing water is difficult to obtain.

4. Tableware bowl in the canteen of SD Inpres 1 Tatura 1,727 CFU / cm². Of the sample test does not meet the health requirements. The shape of the bowl is round and easy to rub with a washing sponge, but is not done properly when washing. Thus, in the primary school canteen, there is no washing with running water, only using water storage containers (buckets, trays), and drying using a cloth that is used repeatedly without being replaced so that it becomes a good medium for microbes.

How to wash cutlery should be done in a way, namely rough cleaning by removing food scraps on cutlery using a clean cloth using detergent / soap, then rinsing in a basin filled with clean water three times then stored on a dish rack and cover with a cloth. So that germ or bacteria do not land and multiply on the tableware [14]. And also the correct dishwashing technique according to the Ministry of Health (2009) consists of several steps, namely: Separation of dirt or food waste from cutlery, soaking (soaking can use chlorine water or by using warm water at a temperature of 82-100°C, washing, rinsing with clean and running water, draining / drying [6].

The results of the research that have been carried out are in line with the results of research [5], the large number of colonies on cutlery is due to the washing / soaking process which contains dirt from the previous rinses, so that it will accumulate in the soaking water used and result in contaminating other equipment. Research [15], the number of germs on cutlery in the canteen are more than the number of germs allowed, the process of drying and storing cutlery is a major factor in the number of germs on cutlery. Research [11], the behavior of handlers during the washing process and after washing cutlery is stored or drained to dry in an open place so that it can be contaminated by dust, bacteria and disease-carrying vectors and can also be caused at the drying stage, contamination of storage damps and not protected from disturbing vectors, as well as final contamination before use of the equipment comes from the personal hygiene conditions of the handlers during direct contact with the equipment.

The results of this study are not in line with the research [2], which states that the washing technique is P value = 0.436 with a 95% confidence level and POR = 0.600 (95%; CI = 0.152 - 2.362), and tableware drying technique. P value = 0.772 with a confidence level of 95% and POR = 1.202 (95%; CI = 0.346 - 4.176), there is no relation to the total number of germs on tableware.

4. Conclusion

Based on the results of the research obtained, it can be concluded that all the cutlery samples taken from the elementary school canteen of the UPTD Puskesmas Mabelopura work area do not meet the eligibility requirements in accordance with the Republic of Indonesia Minister of Health Regulation No.1096 / Menkes / Per / VI /
2011 regarding the requirements for tableware, which are not may contain bacterial colonies or 0 colonies / cm² surface.

References


Development of a Green City Concept Through Waste Management to Increase Community Income

Rukhayati¹, Sri Haryani², Pariyati³
{rukhayatiumar@gmail.com¹, sriharyanibuna04@gmail.com², pariyati24@gmail.com³}

Departement of Economics, Universitas Muhammadiyah Palu¹, Departement of Economics, Universitas Muhammadiyah Palu², Departement of Social and Political Science, Universitas Muhammadiyah Palu³

Abstract. The development of the green city concept has not been accompanied by the increasing volume of high waste production in Palu City. Of course, this condition is a special note for the government in making Palu a waste-free city. To help realize zero waste and realize the concept of a green city, this research aims explicitly to determine the leading waste management program that has been carried out at TDs3R Avosalae in Palu City, then to empower the community about how the market potential and marketing strategies for utilizing this waste the results of processing will be disseminated to the public. Besides, this activity is expected to be able to move from upstream to Silae village, so that this program can improve the welfare of the community and provide an example for other villages to help create a waste-free city of Palu by moving waste innovation into economic goods in an effort increase in community income.

Keywords: Waste, participation, added value, sustainable

1 Introduction

The issue of green city implementation has become increasingly interesting to test. This is related to the assumption that a green city itself is the government's plan to create a city with good governance, characterized by an environmentally friendly theme that can use natural resources in a balanced manner to create a prosperous society. Urban development, accompanied by an increase in population size and density and an increase in the community's socio-economic activities, will result in an increasing amount of waste from day today. Garbage is a life consequence that often causes problems, and the amount will increase along with the increase in community activities. [1]

The rapid development has an impact on the growing problem of waste in Palu City. This can be seen from the increasing population, which resulted in the high volume of waste produced in Palu City. In everyday life, humans cannot be separated from garbage; whether it is garbage that must be disposed of at home, at the office, or where we are, this makes the volume of waste increase. Of course, this condition is a special note for the city government in realizing a waste-free city. The city government has implemented a Waste Management Strategy with the 3R principle (reuse, reduction, recycle) as regulated in the Palu city regional regulation to create zero waste. [2]

TDs3R (Temporary Dumpsite Reuse, Reduction, Recycle) is one indicator of environmental management's success in dealing with waste problems by following under the
government's plan to realize the waste management program. [3], [4]. The role of all stakeholders is essential so that there is no shrinkage of green space. Therefore in the provision of green open space, it is not only the task of the government, but the community also has the right to obtain information openly about the planning and arrangement of green open space, which is responsible for managing green open space so that its sustainability, beauty, and function can be maintained appropriately, and play a role in increasing independence, growing to develop pioneering community skills, provision of privately owned land or land for organizing, green open space, and utilizing and administering green open space in yards. Especially considering that existing environmental problems require the participation and responsibility of everyone to participate in solving them. [5]

As it is known, the government's waste is not managed by the community by burning 35%, burying 7.5%, composted 1.6%, or by other means 15.9%. [6] The presence of TDS3R itself mandates that waste management is not only the government's obligation, but waste management is the responsibility of the community and business actors. TDS3R is a Temporary Protection Place with the 3R principle (Reduce, Reuse, Recycle), from now on abbreviated as TDs3R, is a place before waste is transported to the recycling location. Then the waste is collected, sorted, reused, or recycled at an area scale. [3]

TDs3R is a Temporary Dumpsite with 3R principles (reduce, reuse, recycle), from now on abbreviated as TDs3R, is a place before the waste is transported to the recycling location. Then the waste is collected, sorted, reused, or recycled on a regional scale. [6]. TDs3R is a pattern of waste management approaches at a communal or regional scale. This is done with the community's active role in the form of empowerment for low-income people who live in dense and slum areas. Waste management using TDs3R infrastructure is more directed at reducing, utilizing, and treating waste from sources, which are expected to reduce the quantity and improve the characteristics of the waste before it is further processed at the landfills. [7]

This research specifically aims to determine the development of economic activities through the waste management program that has been carried out at TDs3R Avosalae in Palu City, including whether these programs provide positive input to the surrounding community. The next objective is to analyze other TDs3R Avosalae Palu City's role in supporting waste management activities and a green city concept. It is hoped that this activity can move from the upstream to the downstream of the Silae community so that this program can improve the welfare of the community and provide an example for other urban villages to participate in realizing the waste-free city of Palu and the concept of a green city with the movement of innovating waste into economic value goods.

Waste will have economic value if insufficient quantities are to be traded or processed further as economic goods, both as raw material (recycled) and as a trading commodity. If the community as the waste producer participates in waste management, 3R (reduce, reuse, and recycle), then accommodate and market.

2 Research Method

2.1. Time and Site of Research
This research was conducted in January-March 2020. The researchers used a descriptive research approach, to be precise, using qualitative descriptive research because the researcher intended to describe how waste management in Talise Palu District, the research site is the research location or research locus. The location of this research is the area of Talise District,
to be precise, TDs3R Avosalae Palu City. This type of research is qualitative, so the sampling technique chosen is the snowball sampling system (snowball sample), namely the technique of determining the sample, which is initially small in number. This sample has more friends to be sampled, meaning that the researcher is pointing wrong. One key informant and the critical informant appointed the next informant [8]. These considerations are associated with a small population, so that one informant is asked to show several experts who can be interviewed, then the required number of respondents is obtained. The informants in this study were: Head of Section of Environmental Control and Research Division of Central Sulawesi Province, Head of Implementing Section of Central Sulawesi Regional Settlement Facility, Official Commitment Maker for Environmental Health for Settlements in Central Sulawesi, and Head of TDs3R Avosalae Manager for Palu City.

2.2. Data Analysis Method
Methods of activities that will be carried out through socialization, introducing activities to the community of Silae Village, Ulujadi District, Palu City, field surveys, studying the environmental conditions of Silae Village, Ulujadi District, and social and cultural situations, business management education and training, this activity is carried out in a series of activities Entrepreneurship Motivation. This material focuses on adding insight into the strategy of pioneering and developing a waste management business and Management Development, providing knowledge of group management with good management, which aims to increase the income and welfare of its members.

The collecting data technique is done by observation, interview, and documentation. [9]. This research's analysis model is descriptive qualitative analysis, an analytical method that uses an analytical approach from the researcher's point of view as the primary analysis tool. In this analysis method, the results of exploration are presented or described to answer the formulation of research problems. Other data will also complement data analysis to get more complete results. [8]. Measurements carried out in this study are in the form of direct measurements using a Likert scale (1 to 5) to obtain a category of answers, the results of informants' responses in an interview, to be able to provide an interpretation of the frequency distribution found is large or small. [8]. The primary data source in qualitative research is words or actions; the rest is additional data, such as documents, photos, etc. In this regard, the types of data used in this study are words or actions, written data sources, photos, and statistics. [8], efforts to maintain credibility in research are through the following steps: Extension of observations, increasing persistence, triangulation, using reference materials, and using member checks. [8]

3 Results and Discussion

3.1 Increase in the economic value of the product
Most of the waste management programs appear from community/environmental activists, and although the waste management policy has been effective, it has not been optimally implemented due to several factors. As for the impact of waste management, namely, community awareness is starting to form, additional income for the community is obtained. [10]

The results of interviews with several communities indicated that there was no program sustainability. In contrast, the community was very enthusiastic about carrying out the main
program, which could increase the economic value of waste products and increase their income. It is the same as stated by Mrs. Hawang as the head of Temporary Dumpsite Avosalae, that the additional funds provided by the government for the management of handicraft-making training programs are only limited to completing training activities without any sustainability because there is no forum or forum as a place to accommodate all aspirations regarding continuation. As well as the results of the program.

<table>
<thead>
<tr>
<th>No</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Environmentally friendly</td>
<td>Self-discipline</td>
</tr>
<tr>
<td>2</td>
<td>Produce recycled items</td>
<td>Patience and tenacity</td>
</tr>
<tr>
<td>3</td>
<td>Additional income</td>
<td>Product variations</td>
</tr>
</tbody>
</table>

Table 1. Strengths and Weaknesses of the Waste Management Program

From the compilation analysis results, it is found that there are advantages and disadvantages in the development of economic activities through the waste management program that has been carried out at TDs3R Avosalae, Palu City.

1. Waste management activities or programs have the advantage of being environmentally friendly, of course, they can reduce the volume of waste, its just that hard work is needed for each person to be able to discipline oneself with a small example, namely disposing of garbage in its place, waste processing programs, of the results of interviews with several people around Temporary Dumpsite Avosalae, sometimes witnessed that they still lacked discipline in disposing of trash, even though public trash bins were provided. Still, the trash they brought was just thrown away in any place, even outside the public trash bins that had been provided.

2. Good waste management can produce recycled goods. That is what Temporary Dumpsite Avosalae did. The head of the management revealed that some housewives are empowered to sort waste that can still be recycled and have economic value. These housewives are employed indeed. They must have patience and tenacity in processing and recycling processes to become goods with economic value. This is the benefit they get from the training program to recycle waste into economic goods and, of course, impact the income they earn.

3. The community around Temporary Dumpsite Avosalae, especially homemakers, garbage collectors, can feel the impact of waste management, at least reduce unemployment, which usually homemakers gather and tell each other which is useless, they can now take advantage of the opportunity to increase skills and income through waste management, it has just that a container that can accommodate their recycled products is needed, because all this time the recycled products they do are only stored in a small room, causing accumulation and can damage economic value, they need to be supported for management. The central management is marketing distribution and financial management so that the management of the Avosalae Temporary Dumpsite group is well organized.
The increase in the product's economic value can be seen in Table 2, where it turns out that an item that is considered worthless turns out to have a reasonable value after being processed, so it needs more organized management. The results of the processing that has been done can provide additional income. Creating jobs will also reduce the unemployment rate and automatically increase income for low-income people in the Silae Village, Palu City, to participate in managing waste into compost and crafting plastic waste into handicrafts. Community empowerment through waste management is expected to improve the welfare of the community in Silae Village. Besides, it is hoped that it can become a pilot for other urban villages or even for the private sector to make waste innovations into economic value goods, which will ultimately make Palu a green and waste-free city.

3.2. The participation of TDs3R Avosalae in supporting waste management activities and developing the green city concept

The hope of changing people's views in assessing waste as an alternative resource can be done by reusing it through a recycling process or using it directly, where waste is converted into a reduced at source and resource recycle approach through the implementation of the reuse, reduction, recycle. There are five stages of waste handling: sorting, collecting, transporting, processing, and finalizing waste. With this waste processing, it is hoped that it can minimize the piles of waste disposed of in the landfills. [7]

Green city development itself includes "three pillars of sustainability theory and a variety of other issues such as health, greenery, resilience, and equity. Environment-related issues are by far the most often presented in green city definitions, concepts and methods "[11]; in simple terms, it can be assumed" Cities are responsible for many of our current global environmental challenges, ranging from air pollution to sanitation issues. [12]

In applying the concept of green cities and waste management, public awareness is urgently needed by the community to apply reuse, reduction, recycle management methods: carrying shopping bags, buying recycled products, repairing and reusing old products, separating organic and inorganic waste, and making handicrafts from used materials. [13] Besides that, their understanding of green cities needs to be improved through sustainable

<table>
<thead>
<tr>
<th>No</th>
<th>Processed Waste</th>
<th>Process</th>
<th>Product</th>
<th>Management Cost Of Goods Sold</th>
<th>Selling Price</th>
<th>Variant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Straw</td>
<td>Reuse</td>
<td>Wallet</td>
<td>Rp. 1.000/Kg</td>
<td>Rp. 15.000</td>
<td>Rp. 14.000</td>
</tr>
<tr>
<td>2</td>
<td>Plastic (Non-Biodegradable) Plastic spoon</td>
<td>Reuse</td>
<td>Wallet</td>
<td>Rp. 3.000/Kg</td>
<td>Rp. 50.000</td>
<td>Rp. 47.000</td>
</tr>
<tr>
<td>3</td>
<td>Used Cloth</td>
<td>Reuse</td>
<td>Flowers</td>
<td>Rp. 1.000/Kg</td>
<td>Rp. 25.000</td>
<td>Rp. 24.000</td>
</tr>
<tr>
<td>4</td>
<td>Wet garbage</td>
<td>Recycling</td>
<td>Doormat</td>
<td>Rp. 0</td>
<td>Rp. 25.000</td>
<td>Rp. 25.000</td>
</tr>
<tr>
<td>5</td>
<td>Plastic (Mineral Bottle)</td>
<td>Reuse</td>
<td>Decorative Flowers (Large Size)</td>
<td>Rp. 6.000</td>
<td>Rp. 100.000</td>
<td>Rp. 94.000</td>
</tr>
</tbody>
</table>

Table 2. Product Value Added through processing.
socialization. Government support is also urgently needed by providing space for people to participate in waste management actively. People can take advantage of waste processing as an alternative to economic activities to produce recycled products from waste. Of course, economic value can lead to innovations in the use of waste, including recycled products that have been exhibited at both local and national events, organic and inorganic fertilizers. This is what makes Avosalae Temporary Dumpsite a pilot area for waste management.

Table 3. Frequency and Percentage of waste management activities and development of green city concept

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Total Disagree (Bobot 1)</th>
<th>Disagree (Bobot 2)</th>
<th>Answer Doubtful (Bobot 3)</th>
<th>Agree (Bobot 4)</th>
<th>Strongly Agree (Bobot 5)</th>
<th>Amount F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Environmental awareness</td>
<td>2</td>
<td>4,5</td>
<td>10</td>
<td>22,7</td>
<td>25</td>
<td>56,8</td>
</tr>
<tr>
<td>2</td>
<td>Education and Experience</td>
<td>1</td>
<td>2,3</td>
<td>5</td>
<td>11,4</td>
<td>26</td>
<td>59,1</td>
</tr>
<tr>
<td>3</td>
<td>Understanding the concept of green cities</td>
<td>1</td>
<td>2,3</td>
<td>8</td>
<td>18,2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Waste treatment as an alternative to economic activities</td>
<td>1</td>
<td>2,3</td>
<td>0</td>
<td>0</td>
<td>32</td>
<td>72,2</td>
</tr>
<tr>
<td>5</td>
<td>Supporting facilities for processing</td>
<td>1</td>
<td>2,3</td>
<td>5</td>
<td>11,4</td>
<td>26</td>
<td>59,1</td>
</tr>
<tr>
<td></td>
<td>Total Value</td>
<td>2,74</td>
<td>12,7</td>
<td>49,5</td>
<td>15,4</td>
<td>19,5</td>
<td>740</td>
</tr>
<tr>
<td></td>
<td>Maximum Value</td>
<td>1100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Application of waste management activities and development of green city concepts</td>
<td>0,67</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The application of waste management activities and the development of the green city concept in Table 3 shows that the environmental awareness level of the community to create a clean and healthy environment still needs to be regenerated, so it needs regular socialization, from the results of interviews that some people still have not separated their types of waste and because there are Temporary Dumpsite that are far apart so that the garbage is dumped just anywhere. The local housewives make a regular community service program; it’s just that not all community members participate because of their respective busyness even though their enthusiasm is very high for the sake of a clean and healthy environment. The environment will be clean and healthy because all waste can be utilized. The community will benefit indirectly.

Some people experience a lack of understanding of the concept of green cities related to waste management. However, the results of their interviews suggest that tree planting, environmental cleanliness, an arrangement of city parks, and the provision of landfills by type are partly understood by the community only in its implementation. Must be improved, education is needed related to complex environmental problems due to an increase in the volume of waste; this is necessary to build public awareness. The formation of community organizations is generally based on environmental-based community empowerment. Handling
household waste is not an easy problem. The amount of waste production is large every day, and of course, the various types of materials cannot be processed simultaneously. [14] The leading proponent of environmental concerns is based on thinking and, of course, how society behaves itself. Active community participation is an essential thing in waste management actions and other supporting facilities and infrastructure.

Figure 1 above, in principle, shows a model of the green city concept of Avosalae. In principle, Temporary Dumpsite Avosalae is a waste processing place with the 3R concept (reduce, reuse, and recycle) as a form of reducing waste volume. In its implementation and management, it involves the active role of the government and the community so that the success of the waste processing program and the concept of green cities become successful thanks to the community's active role, of course, from socialization to utilization and maintenance, waste management requires serious attention; the handling process as a learning medium becomes a useful parameter with an environmental perspective to foster a caring character for the environment for all of us. [15]

4 Conclusion
The implementation of the waste processing program is still not optimal; this is due to the low participation of the community, even though only partially, but in its implementation, the level of awareness and concern remains the main factor in the success of the program to create an environmentally friendly green city and create economic activities in the form of a processing program. Waste into products of economic value. To ensure the sustainability of
the program, it is necessary to establish integration between the government regarding finance and the provision of facilities and infrastructure and human resource training.

The need for a forum or forum as a place to convey ideas or opinions, so that what becomes the complaints and hopes of the community can be channeled, besides that the role of the government and other private institutions can become the media in the distribution of the marketing of recycled products that have been carried out, government participation, related institutions who will accompany program activities. The form of assistance is to provide strengthening in entrepreneurship and marketing of local products. This collaboration in marketing shows the government institutions' attention to the community to do business and is a form of the concept of business sustainability.

References

[9] Undang-Undang Nomor 18 Tahun 2008 Pengelolaan Sampah
Analysis Interaction Patterns of People In Dongi-Dongi Towards The Management Of Forest Resources

Sitti Aminah1, A Muis2, Livawanti3, Rafiuddin4, R Gailea5
{sittiaminah76@gmail.com1}

Faculty of Agriculture, Universitas Muhammadiyah Palu, 94118 Indonesia1,3,4,5, Faculty of Agriculture, Universitas Tadulako, 94118 Indonesia2

Abstract. The dependence of communities in and around forest areas on natural resources is still very high. The form of interaction is the use of timber and nontimber forest products. This interaction determines and reflects the dependence of the community on the forest. This research aims to determine factors that influence people's interaction patterns in Dongi-Dongi towards the forest and the pattern of their interaction on forest resource management in Dongi-Dongi, Sigi District, Central Sulawesi. The method of the research was conducted by collecting primary data and secondary data. Primary data includes age (X1), an education level (X2), number of family dependents (X3), and income (X4) for 35 respondents and then analyzed using Binary Multiple Regression with SPSS software program to identify factors that influence interaction patterns. Qualitative descriptive was conducted to see patterns of community interaction. The results of data analysis showed that R2 (adjusted R2 squared) obtained a value of 0.843, meaning that 84.3% of forest resource management activities were caused by three variables, the t-test on education (0.024), number of dependents (0.007), and income (0.037). Furthermore, the interaction of people in Dongi-Dongi in managing forest resources tends to show a pattern of extraction interaction: the use of forest resources according to their needs, manages wisely and tries to improve and restore its function.

Keywords: Interaction, Forest, Dongi-Dongi

1 Introduction

Forests play an essential role in the development and have a crucial function in human life. The functions of forests vary, each of which has different factors of importance depending on local situation and conditions. Function mention is the role of forest in maintaining the quality and balance of the environment for humans’ benefit.

The ecosystem function of forest resources benefits the people living in the forest area and those who lived outside. Forest ecosystems also play a role in shaping the community’s cultural diversity due to human interaction with nature, which enables the emergence of appropriate local technologies, languages, types of food, and arts. Therefore, a healthy forest ecosystem condition will strengthen the supporting capacity for various human life processes around it.

Forest area nowadays are under high pressure from the surrounding community, which cause biophysical damage that leads to the disruption of ecosystem balance of forest in the area. This has led to demands that natural resources be maintained for the continuity of their functions. On the other hand, the interests and roles of the community should not be neglected.
Because the local community is close to these resources, they must have the right place according to their capacity and portion. Because in reality, natural resources and the community have long-standing relationships and even the indigenous/traditional people. People who live around the forest highly depend on natural resources. They interact by extracting timber and nontimber forest products, including hunting. The form of interaction between these people and forest areas determines and reflects their dependence on the forests. This occurs in various forest areas, both in production forests, protected forests, and conservation forests.

In general, conservation areas have reached an alarming level of forest land degradation due to forest destruction/encroachment, dry land without any attention to soil conservation principles, and a farming system. This condition illustrates that the forest interaction with the surrounding community as a life support system is not functioning correctly.

In Central Sulawesi Province, especially in Sigi District, the Dongi-Dongi community depends on forest resources. Dongi-Dongi is located in Nokilalaki District, inside the Lore Lindu National Park (TNLL) Central Sulawesi. The existence of TNLL has an essential meaning for the protection of ecosystems and life support systems for the diversity of flora and fauna. Besides, TNLL is also managed with a zoning system and is used for research, science, education, cultivation support, culture, tourism, and recreation purposes. Not only does it play an essential role in the flora and fauna ecosystem, but TNLL is also a source of livelihood for the surrounding community.

The existence of the Dongi-Dongi community in the TNLL area sustains their lives by taking forest products in wood and nontimber and utilizing the land for agriculture/plantations. This situation assumes that the Dongi-Dongi community tends to be seen as encroachment, although this is the community's interaction with forest resources, an adaptation strategy for forest resource management. Therefore, the formulation of the problem in this research are:

1. How is the pattern of interaction between the Dongi-Dongi community towards the management of forest resource
2. Factors influence the interaction pattern of the Dongi-Dongi community towards the management of Forest Resource.

Based on the formulation of the problem, the objectives of this research are:

1. To identify the pattern of interaction between the Dongi-Dongi community on the management of Forest Resource.
2. To identify factors that influence the interaction pattern of the Dongi-Dongi community towards the management of forest resources.

2 Research Method

The research was conducted in Nokilalaki Subdistrict, Sigi Regency, Central Sulawesi Province, from August to October 2016. The research location was selected through purposive sampling, considering that the people in that location depend on forest resources. The tools and materials used in this research were writing instruments, cameras, and questionnaires. Thirty-five respondents were taken through purposive sampling, considering their interaction pattern towards the management of forest resources.

Types of data collected include primary data and secondary data. Primary data were obtained through direct observations at the research location and interviews with respondents.
based on a list of questions that had been prepared. Meanwhile, secondary data were obtained through literature related to research.

The data analysis was proceed using the qualitative descriptive analysis to see the patterns of interaction between the Dongi-Dongi communities towards forest resource management. Qualitative research produces descriptive data in written or spoken words from the object of research and observed behavior [1]. It uses and analyzes Binary Regression to see the factors that influence the community towards forest resource management.

\[ Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 \]

Note:

- \( Y \) = Community Interaction with Forest Resources
- \( X_1 \) = Age of Respondents
- \( X_2 \) = Education
- \( X_3 \) = Income
- \( X_4 \) = Number of Burden

3. Result and Discussion

3.1. Pattern of People in Dongi-Dongi on the Management of Forest Resource

Humans and forests have a reciprocal relationship because humans are part of the forest ecosystem. This reciprocal relationship is a form of interplay between humans and forests. This interaction is a form of community socio-economic activities to meet their needs.

Dongi-Dongi area located in Nokilalaki District, Sigi Regency, Central Sulawesi Province, is one of the areas within the TNLL area. TNLL itself has 217,991.18 ha, located in Sigi and Poso districts, where TNLL is in direct contact with 67 villages. Thus it is hoped that Dongi-Dongi will function as a reduction in the rate of forest degradation.

Historically, Dongi-Dongi was a program of resettlement for isolated communities (PKMT) in 1978, in which villagers in Mount Kamalisi - Mount Gawalise (Marawola District) were placed in Palolo District, Donggala Regency (currently in the region. Nokilalaki District, Sigi Regency). In that place, several residents returned to their original area, and many died because of malaria. The government again carried out local transmigration of residents from Salua Village and from the Pipikoro plains, which are of Kulawi ethnicity (Kulawi District) and from Dolo District were placed in Kamarora A Village Kamrora B Village, Kadidia Village, and Rahmat Village. In the PMKT program, the government promised to provide two hectares of land to each head of the family, but what has been realized so far is only 0.8 hectares on average. According to respondents, DongiDongi was still in the working area of the HPH company PT Kebun Sari that produced Agathis trees. After the HPH PT Kebun Sari contract was over, the government held an effort to unite the Lindu Lore Kalimata Forest area with the Lake Lindu Nature Park and become the Lore Lindu National Park (TNLL) area.

The interaction of people in Dongi-Dongi towards the forest was initially the existence of their forest activities by utilizing existing natural resources to survive, and they take fruit and seeds, fish in the river, collect firewood, hunt, and look for rattan. Generally, the community uses the forest to meet consumption needs and sell it to buy other needs.

The interaction can be seen through forest products in the form of wood. People depend on the wood in Dongi-Dongi to fulfill their daily needs; it uses to build as material for houses, which almost entirely uses wood. This is related to [2] that the use of wood is divided into three categories: building material, household utensil material, and fuel. People in Dongi-
Dongi take/cut trees following their needs, for example, for house building materials. Trees can be cut if they have a diameter of 30 cm. If you cut one tree, then you must replace it by replanting one tree. This is determined based on the agreement of the Dongi-Dongi community, which is regulated in customary rules and if it violates it will be subject to sanctions, this is in line with research [3] that people are generally aware of the need for forests by maintaining, securing and using them as needed.

People do not interact with the nontimber product of the forest due to limited knowledge and skills. Various types of nontimber forest products are found in the Dongi-Dongi area, such as rattan, bamboo, forest honey, palm sugar, medicinal plants, mushrooms, etc. People in Dongi-Dongi take rattan to sell. Some take mushrooms to consume. At the same time, the leaves of Anau are used as the roof of the house. Bamboo trees are used for home furniture (walls), and medicinal plants use them when they are sick.

The form of interaction of people in Dongi-Dongi towards forest resource management is also seen in land use. As time goes by, the generation continues to increase; therefore, limited land will force them to open new land. Land clearing starts from around the place where they live, but they do not cut down trees that produce fruit or seeds, especially when trees are large and continue to grow. The community simply clears the bushes and other lianas and then starts planting perennial crops/plantations and seasonal/crops in their homes' vicinity. People work on their land for 4-5 hours/day. They return home for lunch and rest during the day, but if the land is far, they bring their lunch, so they don't have to go home anymore. The community grows annual crops/plantations such as coffee and cocoa, candlenut, durian, nature, as well as agricultural or seasonal crops such as rice field, corn, cassava, sweet potatoes, vegetables, spices, and so on; this situation is also in line with research [4]; [5]. Annual crops are intended to meet daily needs, and the rest is for sale to fulfill other needs. The community grows local varieties of paddy fields, which are different from those of lowland rice in general. The leaves of cassava plants are used as vegetables, the skin is used for goat food, and some of the fruit (tubers) can be sold. This is in line with research [6]. Whereas cocoa and coffee plants are considered by the community as savings, as in several other studies showing that community interaction with forests tends to be high, marked by the large number of people who fulfill their daily needs from forest areas such as farming, hunting, utilization of nontimber forest products, and others [7]; [8]; [9].

People in Dongi-Dongi manages their land using simple tools such as hoes, sickles, machetes, and others. This is associated with research [10] showing that using simple tools is classified as low-level land use. According to respondents, combining agricultural and forestry crops can provide better benefits from production and costs to land management. The pattern of combining agricultural and forestry crops is supported by the Free Farmers Forum (FPM). This management form is an agroforestry system, namely land use by combining forestry/annual crops with crops. Thus, it can be said that land use by people in Dongi-Dongi goes through three phases, namely, a survival phase, a simply mixed garden phase, and a complex mixed garden phase.

People understand that the land must be carried out wisely and balanced because if it exceeds it, it will harm the environment. Therefore, they keep the environmental balance through mixed gardens (agroforestry system). This pattern is a cropping pattern that can increase land productivity, protect the land from damage, and prevent soil fertility.

The Dongi-Dongi community also carries out plant maintenance both on annual and seasonal crops. For cocoa plants, pruning the branches conducted once every three months and weeding weeds, grass, and other lianas. Whereas in seasonal plants, the maintenance is in the form of cleaning weeds/grass.
Another form of interaction is crop harvesting activities. Harvesting of plants is carried out on the harvest, both for various types of annual crops such as cocoa, coffee and candlenut, petai, and other crops such as bananas, cassava, sweet potatoes, chilies, tomatoes, vegetables, etc.

However, the orientation and motivation on forest resources' dependence will not be the same between generations due to the negative impacts caused by industrialization and interior modernization. This will cause a degradation of the quality of cultural values. Therefore, assistance and counseling are needed both by the government and other non-governmental organizations [11].

People in Dongi-Dongi carry out forest pedestrian efforts through rehabilitation and conservation efforts and utilize the forest and land. The community depends on their livelihoods from natural resources, which are not only on forest production (timber and nontimber) and forest land and on the protection and climatic functions. Therefore, they try always to protect the forest so that the protection and climatic systems continue to function. Rehabilitation efforts were held out through replanting trees. The community also undertook conservation efforts by planting bamboo along the riverbanks. People in Dongi-Dongi see the forest as a source of food, medicine, energy, and clothing and strives to protect the environment because it is their residence and, at the same time, for the continuation of their generation.

The current land use pattern illustrates that people in Dongi-Dongi still cares about the ecological side of the land. They protect the forest and feel responsible for preserving it. This is in line with the research results of [12]; [13]; [14] stated that people conserving forest areas tend to be high because they realize and understand how vital forest conservation is. Local communities' lives depend on existing resources, so that they need to be managed sustainably through actions or activities to keep the natural resources in the forest from becoming extinct. Forest sustainability and the economic life of people in Dongi-Dongi are two things that influence each other.

The dependence of people in Dongi-Dongi towards the forest, to a certain extent, can be seen through the benefits from the resource, namely the preservation of its structure and function. The existence of interdependence between communities and forest resources in line with research [15] states that the longer a person lives and stays in an area, it will have a positive influence so that there is awareness to maintain and to manage the area.

[16] there are four patterns of forest-community interaction, namely: a. Extraction patterns, the use of resources to the limit of necessity controlled by prevailing ethics and norms, use of forest resources wisely and carefully; b. The pattern of exploitation, the consequence of an increase in population and an increase in the necessities of life, causes the social system to separate from the forest system; c. Confrontation pattern, the existence of a high conflict of interest resulting in the absence of clarity regarding the alignment of economic development interests and the need to conserve the functions and benefits of forest resources required by local communities; and D. Cooperative pattern, the existence of similar interests between efforts to improve community welfare (social system) and maintain the sustainability of the structure and function of forest resources.

Based on the description above, the activities of people in Dongi-Dongi towards forest resource management tend to show a pattern of extraction interactions. According to their needs, the community uses forest resources, manages them wisely, and tries to improve restore its functions.
3.2. Factors Affecting the Interaction Pattern of People in Dongi-Dongi on the Management of Forest Resource

Efforts to determine factors that influence respondents' propensity to engage in forest resource activities can be done through analyzing several variables, namely age (X1), an education level (X2), number of family burden (X3), and respondent income (X4). Data analysis shows that R2 (adjusted R2 squared) has a value of 0.843, meaning that three influencing variables cause 84.3% of the tendency of forest resource management activities. The results of the t-test are shown in the following table.

Table 1. Significance level of each variable on the tendency to manage forest

<table>
<thead>
<tr>
<th>No</th>
<th>Variable</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Age(X1)</td>
<td>0.17</td>
</tr>
<tr>
<td>2</td>
<td>Education (X2)</td>
<td>0.024</td>
</tr>
<tr>
<td>3</td>
<td>Family Burden (X3)</td>
<td>0.007</td>
</tr>
<tr>
<td>4</td>
<td>Income (X4)</td>
<td>0.037</td>
</tr>
</tbody>
</table>

Table 1 shows the results of the regression analysis that of the four (4) variables, there are three (3) variables that affect the activities of people in the Dongi-Dongi on forest management, namely education (X2), number of family dependents (X3) and total income (X4), where the t-test on education (0.024), number of family burden (0.007), and income (0.037). The age variable statistic has several more than 0.5, which means that the age variable is not significant or affects community activities on forest resource management.

1). Age (X1)

Age affects the ability and works performance both physically and mentally as well as in making a decision. In general, younger respondents will have relatively well physical abilities and are dynamic in applying new technology. In comparison, older respondents have low physical abilities and rely more on experience to act carefully.

Table 2. Respondents Age State

<table>
<thead>
<tr>
<th>No</th>
<th>Age (Old)</th>
<th>Total Respondent (Person)</th>
<th>Presentation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>≤ 20</td>
<td>3</td>
<td>8.57</td>
</tr>
<tr>
<td>2</td>
<td>21 - 54</td>
<td>31</td>
<td>88.57</td>
</tr>
<tr>
<td>3</td>
<td>≥ 55</td>
<td>1</td>
<td>2.86</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>35</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 2 shows 31 respondents are aged 21-54 years old. The t-test results in Table 1 for the age variable show the number of 0.17, meaning that the age variable does not significantly affect forest resource management. This contrasts with the research results [17] that this age is included in the productive age category, which shows physical potential at work.
2). Education (X2)
The level of education is a formal activity that the respondent has gone through in his life. The formal activity referred to is education, starting from the elementary school level to the next level.

**Table 3. State of Respondents Education Level**

<table>
<thead>
<tr>
<th>No</th>
<th>Education Level</th>
<th>Total Respondent (person)</th>
<th>Presentation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Elementary School</td>
<td>21</td>
<td>60</td>
</tr>
<tr>
<td>2</td>
<td>Junior High School</td>
<td>9</td>
<td>25.72</td>
</tr>
<tr>
<td>3</td>
<td>Senior High School</td>
<td>2</td>
<td>5.71</td>
</tr>
<tr>
<td>4</td>
<td>No School</td>
<td>3</td>
<td>8.57</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>35</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 3 shows that 21 respondents (60%) are in the elementary school education level (SD). The t-test result shows the number 0.024, which means that the level of education has a significant effect on community activities toward forest resources management. Most of the time in his life (respondent), he spent managing his fields and gardens because he does not have other jobs. His life depends entirely on the gardens and fields. The low level of education causes low processing of forest and agricultural products. Generally, people sell their product directly without processing it to reach a higher value. [18] said a person's education could affect creativity in service and increase performance in their work. The increased number of people and limited land can encourage someone to carry out activities in the forest. This is related to the urge to fulfill their daily needs. Also, the low level of education has an impact on business opportunities in other sectors.

3). Number of Burden (X3)
The number of burdens of the respondent's family is measured by the number of family members who depend on the respondent, both for residence and daily living expenses.

**Table 4. State of the Number of Family Burden of the Respondents**

<table>
<thead>
<tr>
<th>No</th>
<th>Burden (person)</th>
<th>Total Respondent (Person)</th>
<th>Presentation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 - 2</td>
<td>16</td>
<td>45.71</td>
</tr>
<tr>
<td>2</td>
<td>3 - 4</td>
<td>17</td>
<td>48.57</td>
</tr>
<tr>
<td>3</td>
<td>≥ 5</td>
<td>2</td>
<td>5.72</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>35</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 4 above shows that 17 respondents (48.57%) own a 3 - 4 burden. The result of the t-test shows a significant level of 0.007, which means that the number of family burden has a significant effect on community activities in the management of forest resource [19] stated that the higher the number of family burden, the more the need will increase and encourage farmers to invite family members to use the forest.
4). Income (X4)
Respondents' income levels are obtained from cocoa, candlenut, and vegetables, as shown in the following table.

<table>
<thead>
<tr>
<th>No</th>
<th>Income (Rp/Year)</th>
<th>Total Respondent (Person)</th>
<th>Presentation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt; 5,000,000</td>
<td>4</td>
<td>11.42</td>
</tr>
<tr>
<td>2</td>
<td>5,000,000 – 8,000,000</td>
<td>23</td>
<td>65.71</td>
</tr>
<tr>
<td>3</td>
<td>&gt; 8,000,000</td>
<td>8</td>
<td>22.85</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Table 5 shows that 23 respondents had an income level of Rp. 5,000,000, - - Rp. 8,000,000, - / year. The t-test result shows a significant level of 0.037, which means that the amount of income level affects community activities in forest resources management. The respondents' low income in the research location was because the community cultivated area was only 0.5 - 1 ha. Besides, respondents did not have the skills to process forest and agricultural products. The land area affects the amount of income. This is in line with research [20] that the increased land area will increase community income. The community clears the forest to increase the area they cultivate, intending to plant crops, and they think that this can help them meet their needs.

4. Conclusion

The interaction pattern of people in Dongi-Dongi in managing forest resources shows a pattern of extraction interaction. The use of forest resources is following the needs. They manage it wisely and tries to improve and restore their function. The results of data analysis show that R2 (adjusted R2 squared) has a value of 0.843, meaning that 84.3% of the tendency of forest resource management activities is caused by three influential variables, namely the level of education (0.024), the number of family burden (0.007), and income (0.037).

References

[6]. Kristin Y, Qurniati R, Kaskoyo H. Interaksi masyarakat sekitar hutan terhadap pemanfaatan


Characterization of the Test of Scientific Reasoning Ability of Static Fluid Material for Prospective Physics Teachers: the Polytomous Rasch Analysis Authors’

Unang Purwana¹, Dadi Rusdiana², Winny Liliawati³

(purwana.u@upi.edu¹, dadirusdiana@upi.edu², winny@upi.edu³)

Physics Education Program Study Universitas Pendidikan Indonesia, Jl. Setiabudhi No 229 Bandung, Indonesia¹,³, Physics Program Study, Universitas Pendidikan Indonesia, Jl. Setiabudhi No 229 Bandung, Indonesia²

Abstract. This study aims to design a scientific reasoning ability test on static fluid material for prospective physics teachers and test the reliability of the test with the analysis of the polytomous Rasch model. The method used is a descriptive explanation. The test is in the form of a description of five questions measuring proportional reasoning ability, probability, correlation, and deductive hypothesis. The test was given to 28 (M=3 dan F=25) prospective teachers in one of the state universities in Bandung. The results obtained are item reliability 0.93, person reliability 0.84, and Cronbach Alpha reliability 0.85 with excellent categories. The result of the raw variance validity test was able to test the diversity of students' scientific reasoning abilities. The difficulty of the questions in the medium category, the accuracy, and the distinguishing power is in the excellent category.

Keywords: scientific reasoning, rasch model, static fluid

1 Introduction

Scientific reasoning ability is essential for science education throughout the world in this 21st century [1]. Scientific reasoning is one of the 21st-century skills and must be given to students and prospective teachers as an effort to prepare them to be able to face global challenges [2-5]. Although content mastery is still emphasized, skills such as formulating hypotheses, designing solutions to problems, and reasoning skills are still considered important [1,6]. Today, the world is more dependent on technology and society, and this makes the understanding of reasoning abilities is becoming increasingly important, especially for developing countries that need to focus on creating a STEM workforce (Science, Technology, Engineering, and Mathematics) [1,7].

Scientific reasoning is the process of applying logical principles to the scientific method, namely looking for problems, formulating hypotheses, making predictions, solutions and problems, creating experiments, controlling variables and analyzing data [8], processing information based on direct observation, and drawing more complex conclusions from the observed object [9]. Scientific reasoning abilities applies the principles of scientific investigation, starting with proposing hypotheses, planning experiments, devising or designing, conducting experiments to conclude [10], combining content knowledge, controlling variables, and using hypothetical-deductive reasoning to find solutions to scientific problems [1,9,11,12]. Scientific reasoning ability affects the level of ease of students in solving a problem [13-16].
Scientific reasoning ability is one of the skills tested in the Programme for International Students Assessment (PISA) test. PISA test results from 2009 showed the student's low scientific reasoning ability. In the PISA test, especially in science, Indonesia ranks 60 out of 65 countries and gets an average score of 383 from the OECD's average score, which is 501. Trends in Mathematics and Science Study (TIMSS) is an international study of students' mathematics and science achievement. The science achievement of Indonesian students in 2011 ranks last, namely 40th out of 40 countries. This is due to the low percentage of correct answers by TIMSS participants. The low ability of Indonesian students in PISA and TIMSS is because students cannot be challenged to think scientifically and have scientific reasoning. So far, education in Indonesia is still focused on the ability to think conceptually alone and have not trained scientific reasoning skills.

In physics education, assessment addresses various forms of scientific knowledge. Most of the existing assessment instruments emphasize the evaluation of content knowledge. This assessment instrument fails to measure investigative ability. This study applies Rasch analysis to help validate assessment instruments in static fluid material to measure prospective high school physics teachers' reasoning abilities. The static fluid is one of the physics materials that require students' reasoning abilities to understand the concept of static fluid in everyday life. Fluid phenomena are physical phenomena that occur in everyday life.

2 Method research

The purpose of this study was to test the validity, reliability, level of difficulty, and distinguishing power of the prospective teacher's scientific reasoning ability instruments. The research method used is descriptive quantitative. The device of scientific reasoning ability on static fluid material is in the form of description questions totaling five questions. Problem no.1 (S1) deals with proportional reasoning, question no.2 (S2) probabilistic reasoning, question no.3 (S3) correlational reasoning, and question no.4 & no.5 (S4 & S5) hypothetical-deductive reasoning. The instrument was given to 28 prospective teachers (3 male and 25 female) in the 5th semester of the 2020/2021 academic year who took part in mechanics courses. Processing and test analysis using the Rasch method with polyatomic data on a scale of 0 to 8 for each question. The information obtained from the Rasch model results is item measure, person measure, and wright map. Before the instrument of scientific reasoning ability was distributed, the device was tested for validation to 3 validators and obtained excellent results.

3. Result and Discussion

3.1. Reliability

Based on the results of data processing in Figure 1, it can be seen that the reliability of the person is .84 logit and the reliability of the item is .93 logit. Personnel reliability is included in the excellent category (0.80-0.90), and item reliability is included in the outstanding category. Besides, Cronbach’s Alpha value is included in a particular type (> 0.83). Based on this reliability data, it can be concluded that this instrument is perfect for measuring the prospective teacher's scientific reasoning ability.
3.2. Validity

Based on the raw-variance data, the results were 69.6% (> 40%). This shows whether the items used can measure the diversity of the respondent's ability. Data from natural variance indicates that the items used can measure the variety of prospective teachers' scientific reasoning abilities.

3.3. Fit Statistic (item analysis)-How much (item difficulty level).

This analysis shows the grouping of each item's level of difficulty regarding the scientific reasoning abilities of prospective teachers. The difficulty level of the thing can be seen through the measured value in the following Figure 2.

---

**Fig. 1. Reliability Test**

**Fig. 2. Item Measure**
This classification uses the logit average value and standard deviation information. Based on the data obtained in Figure 2, it is known that the mean is .00 logit and the standard deviation is 1.06 logit. The sum of the mean and SD values is 1.06 logit (+1 SD). The sum of the 1.06 logit value and the SD value is 2.12 logit (+2 SD). Next, the <1 SD group was obtained by reducing the mean value against the SD value, and it was obtained that <1 SD was -1.06 logit and <2 SD was -2.12 logit. Based on this information, it is known that there are no items that exceed >2 SD and <2 SD or items that are too difficult and too easy (outliers).

Overall, there are two items below the average with codes S4 and S5, namely hypothetical-deductive ability, while the other three-item problems have a difficulty level above the average of 0.0 logit. On the other hand, based on the data from this data processing, the standard deviation value is 1.06 logit. This information shows that the question of a prospective teacher’s scientific reasoning abilities is spreading. The difficulty level of the question items differs from one thing to another. The characteristics of the items that have different levels of difficulty are excellent to be used as an instrument to measure the scientific reasoning ability of prospective teachers in a static fluid material. Through data processing using the Rasch model, information on a difficulty can be obtained more specifically through the mean and standard deviation values.

3.4. How Precise (Level of Measurement Accuracy).

The level of measurement accuracy by items can be known through Standard Error Measurement (SEM). SEM score of >1.0 logit is included in the question category that lacks research power and distinguishing power. Based on the results of data processing in Figure 2, it is known that the SEM value of all items is <1.0. This data shows that all things about static fluid material's scientific reasoning ability have good accuracy and distinguishing power level. Thus, this item is perfect to be used as a measurement instrument.

3.5. Prospective Teacher’s Scientific Reasoning Ability

The scientific reasoning ability of a prospective teacher is shown in measure values with logit as units. There are several classifications of future teacher’s scientific reasoning abilities, as seen in Figure 3 below. Based on the data in Figure 3, prospective teachers' scientific reasoning skills in static fluid material can be seen. With a value of +4.12 logit, the teacher's highest power comes from two students with codes 10 and 22. At the same time, the lowest ability is -2.54 logit from prospective teachers with code 16. Future teachers' power is slightly higher than the average difficulty level of the question items 0.0 logit as in the high, very tall, outlier classification. Overall, this item can distinguish the level of diversity in the prospective teacher's scientific reasoning abilities.
3.6. Wright Map

Based on the data distribution presented in Figure 4, it can be seen that the average line of the reasoning ability level of prospective teachers (.55 logit) is higher than the middle line of problem difficulty level (0.0 logit). This data shows that all future teachers' average ability in answering scientific reasoning questions is higher than the intermediate difficulty level of all questions. There was 16 prospective teacher who had logit scores above the moderate problem difficulty and 12 future teachers who obtained logit scores below the average problem difficulty level. Prospective teachers 10, 22, 14, and 19 were the groups of prospective teachers who had the most success in answering all scientific reasoning questions. Meanwhile, four future teachers, 08, 15, 20, and 16, are prospective teachers who have difficulty answering all scientific reasoning questions. On the other hand, it can be seen that all question items do not have the same problem. All question items have a different difficulty level from S5 as the most challenging item, while S2 is the most comfortable item to answer correctly.
The most challenging problem is hypothesis-deductive reasoning ability. Hypothesis-deductive reasoning ability is a higher-order thinking ability level used by scientists [20]. Hypothesis-deductive reasoning is related to testing the hypotheses obtained through deductive reasoning. A reasoned argument is an attempt to show that a conclusion must follow a set of premises. A deductive argument is valid if its decision follows precisely from the assumption; if the conclusion is correct, then the hypothesis is true. Reasoned arguments make sense if they are right and the premises are true. Deductive reasoning can be a factor that can help a prospective teacher recognize cognitive conflicts and solve the problems [21]. A person's emotions affect one's deductive reasoning. They tend to damage the reason [22]. This is influenced by the balance between two factors, namely personal and physiological relevance, acting independently. This is consistent with the new utility theory [22-25], which suggests that emotions play a significant role in human rationality [22].

4. Conclusion

The purpose of this study was to test the instrument for the scientific reasoning ability of static fluid material of prospective high school teachers. The device includes description questions totaling five questions testing proportional, probability, correlation, and hypothesis-deductive reasoning ability. The results obtained are item reliability 0.93, person reliability 0.84, and Cronbach's Alpha reliability 0.85 with excellent categories. The result of the raw variance validity test tested the diversity of students' scientific reasoning abilities. The difficulty of the questions in the medium category, the accuracy, and the distinguishing power is in an outstanding variety. The scientific reasoning ability test developed is suitable for use.
Acknowledgments. The author would like to thank the head of the science education study program Dr. Ida Kaniawati for motivating me to complete my doctoral studies. Thank you also to Dr. Muslim, who has helped complete the research and provided suggestions for improvement, as well as Dr. A. Rusli for the motivation and advice given.

References
[8] Hanson S. The assessment of scientific reasoning skills of high school science students: A standardized assessment instrument.


Implementation of Problem-Project Based Learning Model in Elementary School

Ilham Aji Asmara Dewa¹, Ristiana Dyah Purwandari²
{ilhamajiasmara@gmail.com¹, ristianadyah@yahoo.com²}

Abstract. This research is motivated by low scientific attitudes and mastery of student concepts in the process of learning Natural Sciences in elementary school. The purpose of this research is to find out the differences in scientific attitudes and mastery of student concepts as a result of the implementation of the Problem-Project Based Learning model. This study used a quasi experimental method with non-equivalent design (Pretest and Posttest) Control Design. The subject of the study was grade V students at Public Elementary School 1 Kaliiori, as many as 34 students. The instruments used are the scale of scientific attitudes and the test of concept mastery. Data analysis in this study using Independent Sample t-test. The findings in this study were every indicator of scientific attitudes and mastery of concepts for the experimental group getting a greater average N-gain from the control group. The average N-gain for each indicator in the experimental group is still in the moderate and low category, while the control group is relatively low. The results showed (1) there is a scientific attitude between students who obtain learning with problem-project based learning and non Problem-Project Based Learning models, average N-gain for Problem-Project Based Learning 0.41 or 41% and non Problem-Project Based Learning 0.37 or 38% (2) There is an increase in concept mastery between students who obtain learning with Problem-Project Based Learning and non Problem-Project Based Learning models, on average N-gain for Problem-Project Based Learning 0.32 or 32% and non-Problem-Project Based Learning 0.19 or 19%. (3) Every stage in Problem-Project Based Learning can facilitate scientific attitude and mastery of the concept of grade V students in elementary school where the research is conducted.

Keywords: Scientific Attitudes, Mastery of Concepts, Problem-Project Based Learning

1. Introduction

Academic year 2020/2021 applied at the level of Public Elementary School 1 Kaliiori is learning using the 2013 Curriculum or thematic learning. Curriculum learning patterns 2013 require students to be scientific in the learning process. Students as learning subjects must play an active role in learning, teachers only act as mentors, motivators and facilitators. A good learning process is expected to improve the understanding of student concept mastery. Mastery of concepts is the ability of students to identify and analyze concepts in theory and application[1]. Mastery of concepts can help students in solving problems that exist in everyday life and to combine the knowledge that students have. Real concepts must be mastered properly by students as this will affect the level of mastery of the concept that will be possessed[2].

Students' achievement in understanding a learning concept is one of the indicators of success. Bloom's learning framework reveals that mastery of concepts is part of knowledge, where knowledge is the first dimension of educational and cognitive outcomes[3]. Categories in the mastery dimension of the concept include, C1 (remember), C2 (understand), C3 (apply),
C4 (analyze), C5 (evaluate), and C6 (create). Mastery of the concept of students that has been obtained can foster the creativity of learners in solving a problem. Based on the description above, researchers define concept mastery is a student's cognitive ability on the theme of 5 ecosystems of grade V elementary school that can be measured through categories C1 to C4 (knowing to analyze).

Based on the results of pre-research obtained through document data, observations and interviews with grade V teachers at Public Elementary School 1 Kaliori, that there are several problems encountered in Public Elementary School 1 Kaliori. In the teaching and learning process is still centered on the teacher, students only listen to the material explanation and then do the task given by the teacher. The learning process is more dominant using lecture methods, so that student involvement in learning is still lacking. Teaching and learning activities have not used innovative and fun learning models that can increase students' interest and learning outcomes. In addition, the utilization of learning media is not optimal because at the time of learning teachers only use text media as a learning medium so that students' enthusiasm in following the learning is still lacking which ultimately impacts the student's learning outcomes that are not maximal.

Facts in the field showed the results of learning midterm assessment of Natural Sciences subjects semester I students grade V Public Elementary School 1 Kaliori showed that most students have not reached the Minimum Completedness Criteria that have been set which is 65. The average Natural Sciences grade V a. is 62.30 and the Average V b class score is 63.00. In accordance with the reality above the learning of natural sciences, there needs to be innovations in innovative learning models and can foster students' ability to be scientific, activate students in the learning process, and increase the effectiveness of ongoing learning so that students get maximum mastery of concepts and are expected to improve the ability of students scientifically so as to improve the learning outcomes of Natural Sciences.

Scientific attitude is one of the factors that can influence the learning process and greatly influence the success of mastery of the concept that will be obtained by students. Scientific attitudes should be developed in the study of Natural Sciences⁴. Scientific attitude was closely related to achievement in science⁵. Students' scientific attitudes are basically no different from other skills (cognitive, social, process and psychomotor)⁶. A positive scientific attitude makes the learning process fun, so that students can master the concept of Natural Sciences well. The indicators of scientific attitudes in this study: 1) Curiosity, 2) Critical thinking, 3) Honesty, 4) Working openly and 5) Discipline⁷, 6) Curiosity, 7) Respect for data/facts, 8) Critical thinking attitudes, 9) Attitudes of discovery and creativity and 10) Open-mindedness and cooperation⁸.

Based on some of the indicators above have a slight difference but in fact the same. Researchers will select and focus indicators of scientific attitudes a) curiosity b) critical thinking attitudes c) honest d) attitudes of discovery and creativity that will be developed in the student's scientific attitude questionnaire. Every learning should develop a positive scientific attitude so that students can master the concept and feel that the conditions in learning have a flexible, pleasant, and inspiring atmosphere. Such an atmosphere occurs in learning so that students' learning activities will be full of meaning and the activities and creativity carried out by students can be achieved optimally⁹.

Researchers want to use a model that allows students to be scientific and master concepts during the Natural Science learning process through real and factual problems. One of the learning models in curriculum 2013 is a combination of problem based learning and project based learning models. Problem-Project Based Learning research has been conducted and combined¹⁰, there are several steps in Problem-Project Based Learning learning, namely: (a)
Forming groups; (b) Orientation of participants on the issue; (c) Tutorial I (building processes in groups); (d) Learn independently; (e) Tutorial II, at this stage the learning aims to bridge the processing of skills; (f) Project and presentation tasks. It is hoped that the Problem-Project Based Learning learning model can actively encourage students to come up with ideas to solve problems and realistic solutions and be directly involved in the process of problem definition, problem solving, decision return, and other investigative creativity. Problem-Project Based Learning learning model is expected as one of the innovative development models that can be applied to the learning of Natural Sciences in Elementary School and can improve scientific attitudes and mastery of student concepts.

2. Method

Research methods are a scientific way to obtain data with specific purposes and uses\cite{11}. The selection of research methods becomes a way to carry out research on the condition that the selected method must be relevant to the topic to be researched. The research method used in this research is pseudo experimental research method or quasi-experimental so the research must be done conditionally while paying attention to the factors that affect the validity of the research results. The experimental quarle had an experimental group (A) and a control group (B) division without random placement procedures\cite{12}. In both groups, both pretest and posttest were conducted but only the experimental group (A) was treated. This explains that the group taken in the study was based on the researchers’ objectives. The pretest and posttest instruments of scientific attitude scale and mastery of concepts in this research are as follows:

<table>
<thead>
<tr>
<th>Number</th>
<th>Indicator</th>
<th>Statement</th>
<th>Question Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Curious attitude</td>
<td>I like to ask the teacher if there is material that I don't understand. (+)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If the teacher asks questions about the lesson, I prefer to be quiet. (-)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I find out what happened in the neighborhood by asking questions. (+)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I am indifferent (or not paying attention) when the teacher explains when the science lesson is taking place (-)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The science material being taught made me want to continue studying Science (+)</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Science lessons are a waste of time (-)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Critical thinking attitude</td>
<td>Suitability of the problem with the material (+)</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Critical thinking questions make students feel challenged (+)</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The suitability of the time given to the number of questions (+)</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The science teaching aids used do not support science learning (-)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The science material being taught makes me lazy to learn Science (-)</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The way the teacher teaches science makes me lazy to learn science (-)</td>
<td>12</td>
</tr>
</tbody>
</table>
3. Honest

When working on the practice questions given by the teacher I am confident in my own answers (+) 13

When doing science questions or assignments given by the teacher I feel bored (-) 14

When doing test questions, I saw a friend's work (-) 15

I dare to represent the group answering questions from the teacher (+) 16

I want all subjects taught like science lessons (+) 17

Science lessons are a waste of time (-) 18

4. Attitude of discovery and creativity

I am passionate about displaying learning outcomes (+) 19

Science subject matter can be applied in life (+) 20

I like to discuss in completing science assignments (+) 21

I am not confident in conveying ideas and ideas (-) 22

I can't understand the material smoothly (-) 23

I can't answer the question smoothly (-) 24

Note: positive statement (+), negative statement (-)

<table>
<thead>
<tr>
<th>Table 2 Instrument pretest and posttest mastery concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator</td>
</tr>
<tr>
<td>Students can recall the concept of Ecosystem (C1)</td>
</tr>
<tr>
<td>Students can define ecosystem (C1)</td>
</tr>
<tr>
<td>Students can Group the type of parser (C2)</td>
</tr>
<tr>
<td>Students can give examples of plants producing food (C2)</td>
</tr>
<tr>
<td>Students can implement the concept of the food chain (C3)</td>
</tr>
<tr>
<td>Students can apply forest conservation methods (C3)</td>
</tr>
<tr>
<td>Students can distinguish the right actions in the use of natural resources (C4)</td>
</tr>
<tr>
<td>Students can find the function of animal breeding related to the preservation of natural resources (C4)</td>
</tr>
</tbody>
</table>

Note: remember (C1), understand (C2), apply (C3), analyze (C4)
3. Results and Discussion

The findings and discussion of this research were obtained from quantitative data based on the results of scientific attitude scale and student concept mastery test. The assessment is based on the findings of pretest and posttest results during the research process. The collected research data was taken from 34 students of Public Elementary School 1 Kaliiori subdistrict karanganyar purbalingga district consisting of two groups of experiments and controls, totaling 17 students in the experimental group as well as 17 students from the control group. The learning process was carried out in the experimental group using Problem-Project Based Learning learning while in the control group using non Problem-Project Based Learning model learning.

3.1. Implementation of Learning with Problem-Project Based Learning Model that facilitates Scientific Attitude and Mastery of Student Concepts

The following are described learning activities conducted in experimental groups that use problem-project based learning models. The prerequisite material in this learning is ecosystem and the core material is the food chain in the ecosystem. The learning process starts from an aperception activity to explore students' initial knowledge with questions and answers about students' understanding of the food chain. The learner's early knowledge plays an important role as he learns about things that have something to do with what is already known\(^\text{[13]}\).

3.1.1. Forming groups

The first step of the Problem-Project Based Learning model is fundamental determination, at this stage the student activity starts from the formation of the nearest house group because the learning conditions in the school have not been possible to be held, then researchers and teachers teach in the student's home and divide the students into several groups. The findings of this activity are when students start face-to-face learning at the student's home with the teacher after a few months of not entering the school the learning activities are diverted by online learning. The initial learning process activities at this stage are very enthusiastic students.

3.1.2. Student orientation to the problem

The next stage of the Problem-Project Based Learning model is the orientation of students on the problem. Student activities at this stage see video shows about the food chain and conduct questions and answers about students' understanding of the process of food chain occurrence and human activities that affect it. In this activity, learning is directed at students active in expressing an idea by formulating problems and explaining the causative factors of the problems in the video impressions about the food chain. The findings in this activity are when students observe the video of learning, interest, motivation, curiosity of students quite well. Because almost all students at this stage seem enthusiastic to listen and see the video show. The enthusiasm comes because for students learning by seeing video shows is very interesting. The conclusion was obtained from interviews with class teachers and student representatives. In this case the learning media in the form of video shows is very instrumental to develop scientific attitudes to increase students' curiosity and motivate students to learn.
use of media in general can cause passion for learning, more direct interaction between
students with learning resources and overcoming the limitations of space, time, energy and
senses\textsuperscript{[14]}.

3.1.3. Tutorial I (building processes in groups)

The next stage of the Problem-Project Based Learning model is tutorial I (building
processes in groups), after a question and answer about video shows that students are
introduced to problems related to the benefits of the food chain around. The problem is
obtained from reading a text about the food chain and looking at the environmental conditions
around the school where the students live. The purpose of reading activities in this stage is that
students are expected to be able to ask questions about food chain problems, be able to
formulate problems related to food chain problems and be able to identify the causes of food
chain processes in the surrounding environment. The interrelationship of reading with critical
scientific attitudes, reading ability is related to the ability to transfer understanding and solve
problems faced\textsuperscript{[15]}.

At this stage it was found that students still feel ashamed in conveying ideas in
formulating problems or expressing questions. These findings, as reported in previous research,
are in the starting stages with the essential questions questions still arise from teachers, and
students are not used to applying questions that can be used as the beginning of learning
\textsuperscript{[16]}. Therefore, teachers guide them by giving direction or assistance by means of learning support
to students in practicing expressing ideas and formulating a problem.

3.1.4. Self-learning through inquiry

The next stage of the Problem-Project Based Learning model is self-learning through
investigation, at this stage the student experience in getting used to solving problems plays a
role in identifying the causative factors and fostering an attitude of discovery and creativity to
the environment. Childhood experiences have a strong influence on future developments\textsuperscript{[17]}. In
the sense that if a good understanding and experience of the environment is introduced to
students from an early age it will have a positive impact and will shape the attitude of
discovery and creativity in the future.

Direct student involvement in ecosystem conditions in the surrounding environment has
a positive effect and the planting of students’ scientific attitudes towards the surrounding
environment. Students are introduced to how the food chain is growing and efforts to maintain
its sustainability. Direct interaction in learning can play an important role in shaping a
collaborative learning environment, having a positive effect on enabling students to trigger
reflective thinking and make learning more flexible in relation to time and place\textsuperscript{[18]}. The next
activity is for students to have discussions with their groups to develop problem solving steps
on the object of their observations. Discussion activities play a role in facilitating students to
exchange opinions with their friends in determining questions and choices to be decided\textsuperscript{[19]}.

3.1.5. Tutorial II (bridging skills processing)

The next stage of the Problem-Project Based Learning model is tutorial II (bridging skills
processing), at this stage students conduct discussions to determine which projects will be
made based on student observations and source search results (reading books and browsing the
internet) about the food chain. This is like the results of research that explains decision-making
skills using authentic or real problems in the field and small group discussions in decision making, the need for exploration and clarification of available evidence[20]. At this stage students can determine the project or product that will be made to overcome the problems that arise based on the results of observations during the learning process that has been done.

This stage students and their groups with the guidance of teachers draw up a project creation schedule ranging from project planning to report making and project publication. The findings at this stage are the determination of the project schedule carried out by the teacher with the agreement and readiness of the students. This is done by considering the time, so that the learning process with the Problem-Project Based Learning model can be carried out as planned.

3.1.6. Project assignments and presentations

Student activities with their groups during project activities are recorded in the rubik of project creation activities. The findings in this stage are the cooperation of students with their groups in the process of making projects and discussions in bringing up ideas for the project to be made. Projects created by students contain creativity such as groups that create posters about solicitation to maintain the ecosystem environment around students created in a circular form that posters are usually made square. The creative product category is to the extent that the product is new (original) is very rare among the products made by students with the same experience and training, causing surprises (surprising) before giving the assessment of students even shocked and gave rise to the idea of other original products[21]. Here's an image of learning activities at the project and presentation task stage.

![Figure 1 of the student's project or work](image1.png)  ![Figure 2 Student activities are pasting the results of the project solicitation let's keep the ecosystem in the environment](image2.png)

Entering the presentation activities, the findings at this stage are when the group presents the project made, there is a question and exchange of opinions in providing criticism and suggestions to the group presenting. The process of receiving criticism, input and suggestions makes the learning process Problem-Project Based Learning can facilitate the scientific attitude of students in receiving opinions or inputs from other students. The number of inputs in the form of ideas for the project presented by each group, indicates that the attitude of discovery and creativity of students has begun to form. Strategies that can be taken to improve children's creative thinking involve children in telling or presenting as many ideas as possible[22]. The findings were further after the group presented the benefits, advantages and disadvantages of the project being created, then each group carried out the action/demo. The
action here is that students interact directly with the community towards the project being created, so that the resulting project can be utilized for the general public. When carrying out group actions that create posters to preserve and preserve the ecosystem, providing socialization to students and elderly students in the surrounding environment to maintain and preserve it.

The learning process implemented in the control group using the non Problem-Project Based Learning model was carried out at the same time and material as the experimental group for each meeting. The learning process carried out in the control group starts from students being assigned to read a discourse, make questions from reading results, conduct group discussions, conduct question and answer questions, teachers explain the subject matter and students do tasks, occasionally teachers conduct learning in the form of games while singing. The material given to the control group is the same as the material given to the experimental group for each meeting. The difference is that the control group of learning process takes place naturally as in their daily life. The learning model presented does not follow the syntax of the existing learning model or often changes according to the way the teacher is delivered.

Overall, based on the analysis above conducted on the implementation of learning with Problem-Project Based Learning and non Problem-Project Based Learning models on food chain materials, it can be concluded that every stage in Problem-Project Based Learning learning can facilitate scientific attitudes and mastery of the concept of grade V students in elementary school where the research is conducted.

3.2. Differences in Student Scientific Attitude Improvement through Problem-Project Based Learning Model and Non Problem-Project Based Learning Model

3.2.1. Differences in Students' General Scientific Attitudes

To see the difference in scientific attitude improvement between students who obtain learning with Problem-Project Based Learning and non Problem-Project Based Learning models, then the researchers gave pretest at the beginning of learning and posttest at the end of the learning process to two groups namely experimentation and control. The following table is presented showing the results of descriptive quantitative analysis in the form of the acquisition of average values of pretest and posttest, N-gain scientific attitude for two groups of experiments and controls, namely as follows:

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Pretest</th>
<th>Posttest</th>
<th>N-gain</th>
<th>SD</th>
<th>Nor</th>
<th>Hom</th>
<th>Ta</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>17</td>
<td>50.14</td>
<td>70.66</td>
<td>0.41</td>
<td>0.02</td>
<td>0.101</td>
<td>0.53</td>
<td>4.051</td>
<td>2.110</td>
</tr>
<tr>
<td>Control</td>
<td>17</td>
<td>46.47</td>
<td>66.47</td>
<td>0.37</td>
<td>0.08</td>
<td>0.824</td>
<td>0.53</td>
<td>4.051</td>
<td>2.110</td>
</tr>
</tbody>
</table>

Note: number of students (N), average (A), standard deviation (SD), normality (Nor), homogeneity (Hom), Tcount (Ta), Ttable (To).

Level of signification in α = 0.05

Table 3 shows the posttest average values of both groups, the experimental group is superior to the control group. Significant differences can be seen in the 20.52 superior experiment group and the control group increased by 20. Based on table 3.1 that it can be
concluded that $H_a$ is accepted, because $T_{thitung}$'s value is greater than $T_{table}$ and is located in the $H_0$ rejection area. So the research hypothesis there are differences that state that the improvement of students' scientific attitudes in the learning process using Problem-Project Based Learning and non Problem-Project Based Learning is acceptable.

### 3.2.2. Differences in Student Scientific Attitudes Based on Indicators

The $N$-gain calculation of each indicator of scientific attitude is based on data on the value of attitude scale processing obtained from the experimental group using Problem-Project Based Learning learning and the control group that got the learning with the non Problem-Project Based Learning model. The following table is presented showing the results of descriptive analysis in the form of average pretest and posttest values, standard deviation, and $N$-gain in percent (%) for each indicator of scientific attitudes as are as follows:

<table>
<thead>
<tr>
<th>No</th>
<th>ISA</th>
<th>Experimental Groups</th>
<th>Control Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pretest</td>
<td>Posttest</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>SD</td>
</tr>
<tr>
<td>1</td>
<td>Curious attitudes</td>
<td>53,4</td>
<td>7,47</td>
</tr>
<tr>
<td>2</td>
<td>critical attitudes</td>
<td>50,5</td>
<td>9,66</td>
</tr>
<tr>
<td>3</td>
<td>honest attitudes</td>
<td>42,0</td>
<td>5,01</td>
</tr>
<tr>
<td>4</td>
<td>attitudes of discovery</td>
<td>53,5</td>
<td>11,8</td>
</tr>
</tbody>
</table>

Note: number (No), indicators of scientific attitudes (ISA), average (A), standard deviation (SD), N-Gain % (N-G)

Table 4 shows learning on the theme of 5 food chain material ecosystems in grade V elementary school, both the experiment group and the control group all resulted in a positive $N$-gain average on all indicators of students' scientific attitudes. It can be proven that learning using Problem-Project Based Learning and non Problem-Project Based Learning can improve students' scientific attitudes. A significant difference was found in the experimental group that obtained an average $N$-gain higher than the control group. The more detailed explanation of the findings of each indicator of scientific attitude can be explained as follows.

#### 3.2.2.1. Curiosity

The findings in the curiosity indicator are the average $N$-gain value of scientific attitudes for curious attitude indicators in the experimental group (49.67%) moderate category, and control group (11.73%) classified as low category. The $N$-gain for the experimental group was better than the control group by a difference (37.94%) It is said to be better because the experimental group that got the learning with Problem-Project Based Learning, especially the food chain material in grade V elementary school can facilitate the development of students'
curiosity. The embodiment of this attitude is reflected in student activities in the first and second stages of the Problem-Project Based Learning model. Students are taught to make formulations and factors that cause problems related to the food chain. In addition to the knowledge gained in the first and second stages of Problem-Project Based Learning is also taught planting attitudes.

From the results of the analysis of students' grades on indicators of curiosity, obtained data of a number of students who got a score of 100 or all four statement items on the numbers 1 to 4 who got a score of 4. At the time of posttest, the experiment and control group each numbered 3 students (18%) but the average value of the experiment group was superior to the control group of 77,05 and 53,52 or a difference of 23,52.

3.2.2.2. Critical Thinking

The findings in the critical thinking attitude indicators are the average N-gain value of scientific attitudes for critical thinking attitude indicators in the experiment group 41,66 classified as medium category and control group 7,89 classified as low category. The N-gain for the experimental group was better than the control group with a difference of 33,77. In the Problem-Project Based Learning model, learning facilitates students to develop critical thinking attitudes. This attitude is reflected when students do group work in completing projects to solve problems about the food chain around, in stages three and four.

From the data of the results of the score analysis on indicators of critical thinking attitudes of students, obtained data of students who got 100 for the experimental group of 7 students (41%) and a control group of 4 students (23%). The average posttest value of the experimental group was superior to the control group's 71,17 and 48,52 or a difference of 22,64.

3.2.2.3. Honest

The findings in the honest indicator are the N-gain value of scientific attitudes to honest indicators in the low category experimental group. In the experimental group (38,07%) category and control group (18,62%) classified as low category. A significant difference was found in the experimental group that obtained an average N-gain higher than the control group. From the results of student grade analysis on honest indicators, data obtained the number of students who got a score of 100 for the experimental and control group of 5 students (14%) the average value of the experiment group was superior to the control group of 64,11 and 51,17 or a difference of 12,94.

The average posttest score of the honest attitude of the experimental group was superior to the control group because the students' initial understanding of the indicators already existed before the research process was conducted. This causes the learning model to be used both Problem-Project Based Learning and non Problem-Project Based Learning has no significant effect.

3.2.2.4. Attitudes of discovery and creativity

The findings in the attitude indicators of discovery and creativity are the average value of N-gain scientific attitudes for indicators of attitudes of discovery and creativity in the experimental group (36,07%) category and control group (7,53%) classified as low category. The N-gain group was ahead of the control group by a margin (28,53%). In the Problem-
Project Based Learning model, learning facilitates students to develop attitudes of discovery and creativity, the attitude is reflected when students do group work in stages five and six. The expected attitude of the learning outcomes at this stage is to save the environment by creating projects to solve environmental problems and sort out organic and inorganic waste by conducting demonstrations on how to dispose of waste properly. The emergence of both attitudes is poured in the form of projects made by students, such as for garbage and saving the environment there are groups that make posters or ideas to invite students.

From the results of the analysis of student grades on indicators of attitudes of discovery and creativity, data obtained the number of students who got 100 for the experimental group of 10 students (58%) and a control group of 2 students (12%). The average score of the experimental group was superior to the control group at 70.29 and 45.88 or a difference of 24.41.

3.3. Differences in Improving Student Concept Mastery through Problem-Project Based Learning and Non Problem-Project Based Learning Models

3.3.1. Differences in the Student Concept Mastery in General

To see the difference in concept mastery between students who obtained learning with Problem-Project Based Learning and non Problem-Project Based Learning models, the researchers gave pretests at the beginning of learning and posttest at the end of the learning process for two experimental and control groups. The following table is presented showing the results of descriptive quantitative analysis in the form of pretest and posttest average values, N-gain mastery of concepts for two groups of experiments and controls are as follows:

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Pretest</th>
<th>Posttest</th>
<th>N-gain</th>
<th>SD</th>
<th>Nor</th>
<th>Hom</th>
<th>Ta</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>17</td>
<td>47.5</td>
<td>64.85</td>
<td>0.32</td>
<td>0.14</td>
<td>0.103</td>
<td>0.491</td>
<td>3.059</td>
<td>2.110</td>
</tr>
<tr>
<td>Control</td>
<td>17</td>
<td>52.5</td>
<td>61.91</td>
<td>0.19</td>
<td>0.11</td>
<td>0.868</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: number of students (N), average (A), standard deviation (SD), normality (Nor), homogeneity (Hom), Tcount (Ta), Ttable (To)

Significance level at $\alpha = 0.05$

Table 5 shows the average posttest results of the experimental group is superior to that of the control group. Significant differences were found in the superior experiment group 17.4 and the control group up 9.41. The distribution of values in the experimental group was more evenly distributed than the control group. This can be seen from the standard value of N-gain deviation for the experimental group superior to the control group. Based on table 3.3 it can be concluded that Ha is accepted, because thitung value is greater than Ttable and located in Ho rejection area. So the research hypothesis that states there are differences in mastery of the concept of students learning with Problem-Project Based Learning and non Problem-Project Based Learning is acceptable.

The low average value of N-gain mastery of concepts in this study is due; first, at the time of the implementation of the concept mastery test, the condition of the students in the houses next to it is less conducive, so it affects the students who are doing the test in the room.
This condition also makes the result of obtaining value during the pretest between the experimental group and the control is not maximal. Activities to encourage children’s creativity as a whole, one of which is that children need to feel comfortable and stimulated in the classroom. Second, from the results of analysis during the pretest activities, and interviews with teachers and student representatives, it was obtained that the students of both classes were not used to working on the concept mastery. Especially the questions in the form of descriptions that issue high thought processes, so that the average student’s answer is not in accordance with the commands in the question. So far, students have been given questions based on the questions contained in the student handbook in the form of multiple choice and short stuffing. Students still have difficulty in answering questions in the form of description kaerena answers students are still a form of short answers, not elaborated. If the student has become accustomed to solving the problem of the form of the story, then it will automatically know what is known and what is asked of each question, according to his habits.

Third, if reviewed from the level of completion, where learning is said to be complete if the student has mastered 65% of the material, then the level of completion of learning for mastery of the concept of the posttest results of the experimental group is 64,85% (category not yet completed) and for the control group 61,91% (category not yet completed). When viewed from the level of individual completeness achieved by both groups, the data obtained by students who mastered the material 65% and above there were 5 students for the experiment group and 1 student for the control group. The data can be seen in the attachment. From the data, in general, the completion of concept mastery for experimental groups and control groups can be said to be incomplete. Fourth, the learning done before the research is only learning that follows the stages in the material in the textbook online. Learning is more verbal and assigning tasks during the coronavirus pandemic. This condition also makes it difficult for students to understand the lesson and not able to connect the concept with the other concept or the student has not been able to connect the subject matter with the situation of daily life.

3.3.2. Differences in in Concept Mastery Based on Cognitive Domain

The difference in N-gain is each realm of cognitive mastery of concepts. The following table is presented showing the results of descriptive quantitative analysis in the form of average pretest and posttest values, standard deviation, and average N-gain in percent (%) for each realm of cogtive mastery of concepts, namely as follows:

<table>
<thead>
<tr>
<th>No</th>
<th>MCI</th>
<th>Experimental Groups</th>
<th>Control Groups</th>
<th>N-G</th>
<th>Pretest</th>
<th>Posttest</th>
<th>Pretest</th>
<th>Posttest</th>
<th>A</th>
<th>SD</th>
<th>A</th>
<th>SD</th>
<th>A</th>
<th>SD</th>
<th>A</th>
<th>SD</th>
<th>A</th>
<th>SD</th>
<th>A</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C1</td>
<td>47,05</td>
<td>8,48</td>
<td>64,71</td>
<td>15,62</td>
<td>33,33</td>
<td>47,06</td>
<td>8,48</td>
<td>62,35</td>
<td>15,62</td>
<td>28,88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>C2</td>
<td>45,88</td>
<td>9,39</td>
<td>67,65</td>
<td>12,51</td>
<td>40,21</td>
<td>58,24</td>
<td>13,8</td>
<td>65,88</td>
<td>21,52</td>
<td>18,30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>C3</td>
<td>47,05</td>
<td>7,85</td>
<td>61,76</td>
<td>9,35</td>
<td>27,77</td>
<td>46</td>
<td>7,07</td>
<td>48,32</td>
<td>8,57</td>
<td>5,22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>C4</td>
<td>53,52</td>
<td>7,85</td>
<td>65,82</td>
<td>21,35</td>
<td>54,71</td>
<td>54,71</td>
<td>6,24</td>
<td>62,35</td>
<td>14,78</td>
<td>16,88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: number (No), mastery of concept indicator (MCI ), average (A), standard deviation (SD), N-Gain % (N-G), remember (C1), understand (C2), apply (C3), analyze (C4)
Table 6 shows that both the experimental group and the control group all produced positive N-gain averages in all cognitive realms of concept mastery. This can prove that learning using Problem-Project Based Learning and non-Problem-Project Based Learning models can improve concept mastery. A significant difference was found in the experimental group that obtained an average N-gain higher than the control group. The more detailed explanation of the findings of each cognitive realm of concept mastery can be explored as follows:

3.3.2.1. C1 (remember)

The findings in the cognitive real of C1 were average N-gain mastery of the concept of cognitive domain C1 in the experimental group 33.33% classified as a moderate category with a posttest average score of 64.71 and a control group of 28.88% relatively low with a posttest value of 62.35. The low N-gain score for the cognitive sphere of C1, from the results of the analysis of students' answers for both groups at the time of pretest, in answering what the ecosystem meant is still incomplete. Students answer questions such as: a system, a reciprocal relationship. At the time of mentioning the example, the student's answer at the pretest time was like; ecosystems, rice field ecosystems, river ecosystems, pond ecosystems. Whereas the expected answer is to mention more than two examples.

The N-gain results of cognitive sphere C1 for the experimental group that gained learning with Problem-Project Based Learning were better than the control group that got non Problem-Project Based Learning learning. In the Problem-Project Based Learning model, teachers play a role in facilitating students to express many ideas, train to ask questions or formulate problems and mention examples based on video impressions and explanations from teachers. Meanwhile, in the control group that got the learning with non Problem-Project Based Learning model, the teacher provided the learning by assigning students to read the reading text and then answer questions about the text. Students are less involved in the process of being discussed, asked questions and trained in formulating problems based on the text read. The same thing in project-based learning is the essential question (start with the essential question)[24]. In this stage the teacher motivates students to be able to ask questions related to the topic, and can direct the student's questions to more specific things.

The next finding of the cognitive sphere of C1 is from interviews with class teachers and student representatives, to find out the difficulty of students in answering questions number one and two (C1). It is obtained that the low cognitive sphere of C1 is caused because students are rarely given the opportunity to ask questions or are less trained in introducing ecosystems in the surrounding environment. In fact, one of the characteristics of students who have good memory is often asking good questions. So far, questions are only submitted by teachers and students to answer questions given by teachers through online media. Students are less involved in active learning situations that encourage students to bring their experiences, ideas, interests, and materials to every meeting offline or online. This is not in accordance with the teaching philosophy that encourages the cognitive ability of C1 i.e. the child should be an active student. They need to be encouraged to bring their experiences, ideas, interests and materials to every meeting offline or online. It is possible for them to discuss together with the teacher about the purpose of working/learning each meeting, and need to be given autonomy in determining how to achieve it.
3.3.2.2. C2 (understand)

The findings in the cognitive realm of C2 were the average N-gain mastery of student concepts for the cognitive sphere of C2 in the experimental group of 40,21% classified as a moderate category with a posttest average score of 67,65 and the control group of 18,30% classified as low category with a posttest average score of 65,88. The low N-gain value for the cognitive sphere of C2 is caused by students having difficulty when students are assigned to mention the components of the ecosystem as well as in the processes that occur within the ecosystem based on the understanding associated with the situation of residence. The average answer to questions 3 and 4 has similarities in mentioning components and the answers are short without being described. Students just answer like; abiotic components and biotic components.

The N-gain results of cognitive sphere C2 for the experimental group who got learning with Problem-Project Based Learning were better than the control group that got non Problem-Project Based Learning learning. In the Problem-Project Based Learning model, teachers facilitate students to discussion with their groups in understanding an idea/gasan related to the ecosystem in the surrounding environment. Meanwhile, in the control group that got the learning with non Problem-Project Based Learning model, ideas in understanding the ecosystem are generally conclusions based on the text read. The role of students is more on listening to the teacher's explanation in understanding the idea or way of solving a problem. The learning conditions in the experimental group are in accordance with the principles of project-based learning, which involves real-life tasks to enrich learning[25].

3.3.2.3. C3 (apply)

The findings in the cognitive sphere applying the average N-gain value of student concept mastery for the cognitive sphere of C3 both groups got a low category. In the experimental group 27,77% were classified as low with a posttest average score of 61,76 and the control group 5,22% classified as low category with a posttest average score of 48,82. The cause of the low N-gain score for the cognitive sphere of C3, from the results of interviews conducted to student representatives of both groups (experiments and controls). Students have difficulty explaining a problem and its relevance to other communities. The difficulty experienced by students is one of the factors, namely the lack of availability of resources to support the learning process.

Existing learning resources, such as student worksheets, printed media and some sources from the internet are less utilized by students. In addition, the learning time is limited, so the opportunity for students to try ideas becomes less maximal. Direct student involvement in the learning process is limited to discussion and question and answer. Students are rarely given the opportunity to explore more with experimental tools and materials. To be able to develop or apply student ideas, teachers should encourage students to come up with creative ideas in solving a problem by using existing learning resources and provide opportunities for students to explore more with experimental tools and materials[26].

3.3.2.4. C4 (analyze)
The findings in the cognitive realm of C4 are that the average N-gain value of mastery of student concepts for the cognitive sphere of C4 both groups got a low category. In the experiment group 26.45% were classified as low category with a posttest score of 65.82 and the control group 16.88% classified as low category with a posttest average value of 62.35. The N-gain for the experimental group was better than the control group with a difference of 9.57%. It is said to be better because the experimental group, which obtains learning with the Problem-Project Based Learning model, facilitates students in the cognitive sphere of C4 at the stage of self-learning through investigation. At this stage, students through their groups together plan the ecosystem in the neighborhood around the residence.

Low N-gain indicators in the cognitive sphere of C4, the results of analysis of data from answers in students were assigned to answer number 8 based on the type of food, describe various animals and beikan examples. Students for both groups answered on average such as; Cows eat grass, lions eat meat. Students still have difficulty analyzing the names of the types of plant-eating animals, meat and eaters of everything.

To be able to understand more of the cognitive realm of C4, the authors conducted a live interview with students to get clarity on the answers given. Data from the researchers' interviews found answers that students responded based on their imagination, or student mindset, but when asked for examples of omnivorous animals students were still at a loss to explain.

4. Conclusion

Every stage in the implementation of Problem-Project Based Learning can facilitate scientific attitude and mastery of the concept of grade V students in elementary school where research. The students' scientific attitudes arise when conducting observations directly in the environment around which students live related to the ecosystem. The results of these observations are followed up and sought to solve the problem in the form of project creation and take real action, namely socializing in general. An example of ilmah attitude as a result of Problem Project Based Learning is the agreement between students and teachers to equally maintain the environment and not litter. Mastery of the concept of students arises when conveying many ideas in formulating problems, making the project related to the act of preserving the environment. An example of the product of mastery of the concept produced by students is a poster containing a call to preserve the ecosystem in the form of a circle that is generally a square-shaped poster.

There are differences in scientific attitudes between students who obtain learning with Problem-Project Based Learning and non Problem-Project Based Learning models. Problem-Project Based Learning model improves scientific attitude compared to non Problem-Project Based Learning model. This can be seen from the average N-gain for the experimental group of 0.41 or 41% and the control group of 0.37 or 37%.

There are differences in concept mastery between students who obtain learning with Problem-Project Based Learning and non Problem-Project Based Learning models. Problem-Project Based Learning model improves concept mastery compared to non Problem-Project Based Learning model. This can be seen from the average N-gain for the experimental group of 0.32 or 32% and the control group of 0.19 or 19%.

References


[10] Purwandari R D 2014 Pengaruh Model Pembelajaran Problem-Project Based Learning terhadap Jiwa Wirausaha Siswa SMK melalui Produksi Eksterior J Saintsks XI


[14] Rudi Susilana dan Capi Riyana 2009 Media Pembelajaran (Bandung: CV Wahana Prima)


[23] Sarjiman 2014 Pembelajaran Soal Matematika Bentuk Cerita dengan Pendekatan Pemecahan Masalah pada Siswa SD (Yogyakarta: Staff Site UNY)

[24] Sari D Y 2014 Memperkuat Upaya Pengembangan Karakter Kemandirian ISIS melalui Project Based Learning (Tesis SPs UPI Bandung: Tidak dipublikasikan)

External Quality Assurance Model in HEIs: 3-D ACS Framework

Maria Magdalena Wahyuni Inderawati¹, PoTsang B Huang², Ronald Sukwadi³
{wahyuni.inderawati@atmajaya.ac.id¹, pthuang@cycu.edu.tw², ronald.sukwadi@atmajaya.ac.id³}

Industrial Engineering, Atma Jaya Catholic University of Indonesia, Jl. Raya Cisauk Lapan, Sampora, Kec. Cisauk, Tangerang, Banten 15345, Indonesia¹,³
Industrial and System Engineering, Chung Yuan Christian University, No. 200, Zhongbei Road, Zhongli District, Taoyuan City, 32023 Taiwan ¹,²

Abstract. Based on pre-existing literature, accreditation, customer satisfaction, and education for sustainable development are essential perspectives in measuring tertiary institutions' quality. A preliminary survey was conducted to identify important aspects of determining higher education quality. The results showed the accreditation requirements had already covered almost all aspects; however, it lacked student satisfaction and sustainable development education. The previous studies showed each perspective had been evaluated separately and has advantages and disadvantages. This paper proposes a novel quality framework consisting of three crucial perspectives: Accreditation ranking, Customer satisfaction, and education for sustainable development, which will be correlated with each other to obtain a comprehensive and holistic measure of the quality for a higher education institution. It is called the 3-D ACS Framework. This paper only presents the surface of the 3-D ACS Framework concept. Henceforth, in-depth research must be carried out to provide a more comprehensive concept of measuring higher education quality.

Keywords: higher education, quality assurance, 3-D ACS Framework

1 Introduction

Higher education institutions around the world are currently experiencing developments and intense competition. Every institution is demanded to have quality. Many studies [1-4] related to the importance of quality assurance in higher education institutions have been conducted in several countries. Studies in European tertiary education institutions have shown that quality assurance is a must. Furthermore, quality assurance should not be carried out in the same way as compulsory technical work or technical work to satisfy the regulations. The essential objective is to make tertiary education competitive, transparent, diversified, and leading globally. Quality assurance would also provide and guarantee high quality research, teaching-learning [1].

Quality assurance in Romanian Higher Education was a legislative matter. Romanian's national system's quality assurance performance depends on the correspondences established between academic quality and transformations in higher education in Romania and worldwide. There were
three fields in quality assurance provided by the Romanian legislation: (1) the institutional capacity, (2) the educational efficiency, and (3) quality management [2].

A study in Cyprus (2016) observed that the use of a global network system should be more common for the effect of quality assurance studies on the world, competitiveness understanding among higher education should be more comprehensive, also higher education institutions should make everyday decisions in the reaching of quality [3].

Higher education is growing with other improvements, such as increasing technology use in learning innovative partnerships between universities and commercial entities and extending students' access. It also a more critical role in economic and social development in the region and globally. In line with these developments, the quality assurance in higher education has reformed and developed worldwide in the last decade, such that research and teaching in higher education is increasingly a global concern [4].

It has become a norm that accreditation is a crucial indicator in measuring tertiary education institutions' quality. Several advantages and disadvantages emerge in the implementation of accreditation. In general, accreditation for higher education is an obligation that must be carried out by an institution. Many benefits are obtained, for example, to increase students' intake, expand collaboration, and have a good impact on competitiveness [5-8]. However, some higher education institutions perceived that accreditation is a written formality to comply with the government's demands rather than improve the institution's quality itself [9]. Therefore, it is not enough to determine the quality of higher education based only on accreditation.

Another activity that is also popular in implementing quality assurance is measuring customer satisfaction. In this case, feedback from students and alumni is useful for institutions to accomplish continuous improvements and increase their quality [10-13].

In line with the world's development today, it has been proposed that universities need to start paying attention to sustainability development. The role of higher education in achieving sustainable development goals has gradually been adopted as one of the indicators of quality in higher education institutions [14-16].

This paper proposes a new framework to determine quality in higher education. This new framework will provide a more comprehensive idea of quality measurement in higher education based on accreditation, customer satisfaction, and sustainable development education. Thus it is expected that when higher education is declared to be of high quality, it will fulfill three aspects of higher education quality: the perspective of accreditation, customer, and sustainable development.

2 Literature Review

2.1 Accreditation

Accreditation is standard in higher education quality assurance. Some countries have national accreditation bodies that are tasked with accrediting institutions or programs. In this case, the government usually requires all tertiary educations to follow this accreditation (mandatory), and usually, the costs are borne by the government. Besides, there is also a voluntary accreditation model. Usually carried out by non-profit institutions by the characteristics of the program. Following
are some examples of independent accreditation bodies: (1) Accreditation Board for Engineering and Technology (ABET), a non-governmental agency accrediting programs in applied and natural science, computing engineering, and engineering technology internationally. ABET accredits programs that have received recognition from national or regional accreditation bodies or national education authorities around the world; (2) Indonesian Accreditation Board for Engineering Education (IABEE) was founded as an autonomous part of the Indonesian Engineers Association (PII) to develop and foster a quality culture in the management of engineering higher education. IABEE accreditation is an international-level accreditation after become signatory of the international accord (Washington Accord for Engineering and Seoul Accord for computing programs). To obtain accreditation from the IABEE, programs must be associated with an institution that has been accredited at least with status B by the Indonesian National Accreditation Body. The programs must be accredited at least with status B (for Provisional accreditation) and at least with status A (for General accreditation) also by the Indonesian National Accreditation Body; (3) Association to Advance Collegiate Schools of Business International (AACSB) provides quality assurance, business education intelligent and professional development services to business schools. To get AACSB accreditation, the school has to become a member and apply for an eligibility application. The eligibility application states that this business school is subject to a national quality assurance regulation from the government or other quality assessment entities. The three examples above demonstrate the requirement to be recognized by the competent national authorities before applying for accreditation.

Previous studies [5, 17-19] stated that the implementation of accreditation policy in private universities positively impacted their competitiveness. It also increased the number of academic qualifications, student intake, facilities, and infrastructure and the cooperation with external parties [6]. The results of research at private higher education institutions in Kota Pakan Baru, Indonesia, showed that in choosing private higher education institutions, prospective students consider accreditation, in addition to the existence of classes for employees, tuition fees, and location [7]. Other studies stated that accreditation was more representative of quality than grade point average (GPA) because accreditation was assessed by external parties [8]. Regarding the issue of internationalization, which is now becoming one of the main priorities of a tertiary education institution worldwide, a study showed that academic quality is the essential things for international students to choose the university, as well as reputation and the presence of international students and staffs [5]. Accreditation is a type of quality assurance that is mandatory for accountability. Accreditation is also a written formal acknowledgment that proves that a higher education institution is compatible with the required standards. Quality assurance will increase university recognition, which impacts equal cooperation, and will further improve student mobility [6].

From the explanation above, it can be concluded that national accreditation is crucial and must be obtained by higher education institutions. Even to get international accreditation, higher education institutions need to receive national recognition first. Thus, it is almost certain that every higher education is required to have national accreditation. However, a study in Omani [7] revealed that the national accreditation a strategically forced tool made under the constraint of accountability rather than an effective mechanism of improvement.

The description above shows that accreditation is essential for quality assurance. Nevertheless, on the condition that accreditation is only perceived as fulfilling government regulations or its nature is voluntary, this is not enough to measure higher education institutions' quality.
2.2 Customer satisfaction

A useful tool for authority decisions to improve the educational policy in feedback mode is monitoring consumers' options of educational services. More accurate and reliable feedback from consumers of educational services could be provided by continuous improvement of public assessment measurement tools [8]. Information for decision-making regarding the quality improvement of the education provided by assessing stakeholders' satisfaction [1].

A study showed a phase of quality management model in higher education base on business process modeling. The paper points out the priority of graduates' satisfaction in assessing quality in higher education institutions. It also acknowledges a critical development that has constructed the idea of correlating the graduates' requirements regarding the developed specific and transversal skills during the study with the labor market's required competencies [9]. University graduates as stakeholders could evaluate their student experiences and the lack of consistency between their training and what employers demand. Complain from students and graduates become inputs to improve university quality [10]. A study stated that service quality is vital for higher education institutions, including the people's perception of the services and how they are delivered [11].

The above description shows that customers' satisfaction is also an important indicator in measuring higher education quality.

2.3 Education for Sustainable Development (ESD)

Amaral et al. (2015) in Ozdemir et al. (2020) [12] stated since the 1970s sustainability concept has been on the list of the world and is being reviewed more and more extensively.

Research defined a sustainable university as follows [13]

“A higher educational institution, as a whole or as a part, that addresses, involves and promotes, on a regional or global level, the minimization of negative environmental, economic, societal, and health effects generated in the use of their resources to fulfill its function of teaching, research, outreach and partnership, and stewardship in ways to help society make the transition to a sustainable lifestyle.”

The improvement of campus sustainability can be made by several forms, including education, green feature in building design, physical changes to existing infrastructure, and changes in facilities users' behavior that will reduce energy use [20]. Lozano et al. (2015) stated the number of universities and industries working together to contribute to sustainability continues to grow. However, most collaborative activities are based on "hard" technocentric solutions for environmental focus; only a few papers addressed "soft" issues in the organization. That paper proposed a new soft solution by developing an integrative course called Organizational Change Management for Sustainability (OCMS) [15].

Ozdemir et al. (2020) also indicated a need for an integrated approach that connects quality service and sustainability in Turkey's higher education. Their research also proposed an instrument called Sustainable Service Quality (SusServQual) [16]. The instrument adapted from Servqual [21] consists of five dimensions related to service quality and sustainability in a higher education institution, namely service to students, physical means, responsiveness, natural resources, and
environmental sensitiveness. Moreover, a study showed that high-quality education in Europe could produce sustainable socio-economic developments [22].

Research by Medne et al. (2020) showed that higher education's sustainability development activities are possible to be integrated through quality system models and development approaches. The study stated that the quality system development approach, such as the European Foundation for Quality Management (EFQM) Excellence Model guides setting a strategic focus on sustainable development in higher education [15].

3 Method

A survey was conducted with respondents from faculty and study program leaders and lecturers who have been involved in the accreditation application process at a well-known private university in Indonesia. A total of 26 respondents have expressed their opinion. Questioners asked about the factors that can determine the quality of higher education. Respondents were asked to answer whether the factors mentioned were important in determining the quality of higher education and whether these factors were already included in the national accreditation criteria or not.

The factors mentioned are the accreditation rating; vision, mission, goals, and organizational strategy; governance; student academic achievement (example: GPA graduated on time); student non-academic achievement (example: art, sports); human resources (lecturers and administrative staff); finance and infrastructure; curriculum and the learning process; research, community service; student satisfaction; as well as education for sustainable development. The results showed that respondents consider all factors necessary by giving scores above 4 for the range of importance levels of 1 for very unimportant to 5 for significant (Figure 1).

Answering whether these factors are already available in the national accreditation criteria, most respondents stated that all factors had been included in the national accreditation criteria. However, student satisfaction with academic services is still considered insufficient; more than 50% of respondents stated that this factor is not listed in the national accreditation criteria. Even for the sustainability development factor, both in the curriculum, research, community service, and operational activities, as many as 50% to 80% of respondents stated that this factor was not available or was not yet available in the national accreditation criteria (Figure 2).

From this survey, it can be concluded that three main factors must be considered in determining the quality of higher education, namely national accreditation, which includes many factors, student satisfaction, student satisfaction in non-academic services, and issues of sustainable development. Student satisfaction and sustainable development factors need to be separately measured because the national accreditation criteria do not sufficiently cover them. Therefore, to get a comprehensive view of higher education quality, these three factors need to be considered.
Fig. 1. The importance level of factors in determining the quality of higher education based on respondents' perceptions.
4 Results and Discussion

4.1 New proposed framework: 3D ACS

Learning from the quality assurance system in Romania and Oman [1,23], there is an assumption that accreditation is seen as fulfilling the government's mandate and is perceived as a formality activity rather than for quality improvement. This means that the results of accreditation are not enough to demonstrate the quality of higher education adequately. Therefore, it is necessary to provide a more comprehensive measure of higher education quality using other perspectives.

Firstly, it is important to measure customer satisfaction. As mentioned above, the measurement of customer satisfaction with university stakeholders, including students, graduates, parents, industrial society, lecturers, and administrative staff, can be an accurate and reliable input for quality improvement. Therefore, customer satisfaction should be a concern for the university. Some universities are already doing it regularly. Another thing that needs to be considered is the appropriateness of the instruments used to measure customer satisfaction. Thus, universities must review customer satisfaction measurements and set the result side by side with their accreditation ratings. Logically, the accreditation ranking would be proportional to the customer satisfaction score. If not, it is necessary to examine the cause further. Measuring customer satisfaction will

Fig. 2. Availability of factors in the national accreditation criteria.
increase the comprehensiveness of the quality of higher education. Sukwadi et al. (2001) stated that
tertiary education challenges mention that service quality attributes are needed to satisfy the students
and are defined in service strategy improvement and development [24]. Adopting students' input on
the institution's strategy improvement and development will ensure quality increasing at the
institution.

Sukwadi & Yang (2012) declared that many mechanisms had been adopted to evaluate and
regularly review the quality of all facets of education services and propose frameworks for the
quality of education services. Student satisfaction is a major driver of any organization's customer
orientation, and higher education institutions are no exception. The research also presented a
framework that would help meet their needs, lead to satisfaction and critical service attributes, and
provide appropriate student perspectives [2]. The instruments for measuring higher education
stakeholder satisfaction are available in several papers, for example, the Servqual instrument [9].

Secondly, the requirements to become a sustainable university that covers environmental,
economic, and social can also become indicators of quality improvement. As stated above, high-
quality education can lead to the development of sustainable socio-economic. This statement also
means that quality universities can contribute to sustainable development goals issued by the United
Nations. Therefore, it is time for universities to realize the importance of implementing sustainability
education in their activities. The activities referred to include "hard" solutions for environmental
focus and "soft" issues covering management policies, behavior change, and education, including
curricula. By including ESD as an indicator of quality measurement, universities will be more aware
of implementing it. Measurement instruments for sustainable universities are also available in
several papers; for example, SusServQual [25].

Previous studies [20 - 23] provide measurement results on these three perspectives separately.
Based on these studies, it is crucial to systematically support accreditation as a quality measurement
for a higher education institution. To enhance the overall quality, therefore, a 3-D ACS Framework
was proposed in this study. Figure 3 shows a proposed model for measuring higher education
institutions' quality that involves three perspectives, namely, accreditation, customer satisfaction,
and ESD.
The coordinates \((a, b, c)\) reflect a new comprehensive measurement of the higher education institutions’ quality. There will be eight different levels of quality. In-depth research is needed to put coordinate in each octane, whether weighting is required for each perspective. Also, the meaning of the eight levels of quality, their implications for higher education institutions, and other interested parties’ impacts will be challenging topic research in the future.

Before arranging the 3-D model, it is essential to know the correlation between the three quality perspectives. Therefore, the first step that will be taken is to conduct research that will look for correlations between the three perspectives: accreditation, customer satisfaction, and sustainability education. The correlation between three quality perspectives will provide opportunities for further research to prove whether the quality level of one perspective can be predicted based on other perspectives. **Figure 4** shows a potential research scheme that can be done, namely, to find the correlation between dimensions (accreditation, customer satisfaction, and ESD) and determine the weight/importance level of each dimension to the quality of higher education. This paper only presents the surface of the 3-D ACS Framework concept. Henceforth, in-depth research must be carried out to provide a more comprehensive concept of measuring higher education quality.
4.2 New proposed framework: 3D ACS

The need to become a high-quality university is a demand for an institution, among others, to attract prospective students, international cooperation to absorb graduates into the workforce. One way that reflects the quality of higher education is accreditation, particularly accreditation mandated by the local government. The indicators in determining the accreditation ranking have covered many aspects, including vision, mission, goals, strategies, governance, curriculum and teaching-learning process, research performance, community service performance, human resources, student affairs, financial, and infrastructure. However, other aspects need to be considered in determining higher education quality, namely customer satisfaction and sustainability education. Customer satisfaction is deemed necessary because the measurement of customer satisfaction, in this case, students' satisfaction, can be accurate and reliable for quality improvement. On the other hand, higher education is also required to contribute to the United Nations' sustainability goals. The quality of higher education can contribute to the development of sustainable socio-economic development. Thus, a quality higher education institution should refer to sustainable education. Each of the three aspects, namely accreditation, customer satisfaction, and education for sustainable development, have their measurement criteria and instruments. However, the measurements are carried out separately. Therefore, a new framework is offered to provide measurement in determining higher education quality through these three aspects. This paper is an initial study and requires further in-depth research to determine the relationship between these three aspects and determine the weight of each aspect to form a three-dimensional framework that includes accreditation, customer satisfaction, and sustainable education (3D ACS framework).
5 Conclusion

A preliminary survey was conducted to identify important aspects of determining higher education quality. The results showed the accreditation requirements had already covered almost all aspects; however, it lacked student satisfaction and sustainable development education. The previous studies showed each perspective had been evaluated separately and has advantages and disadvantages. This paper proposes a novel quality framework consisting of three crucial perspectives: Accreditation ranking, Customer satisfaction, and education for sustainable development, which will be correlated with each other to obtain a comprehensive and holistic measure of the quality for a higher education institution. It is called the 3-D ACS Framework. This paper only presents the surface of the 3-D ACS Framework concept. Henceforth, in-depth research must be carried out to provide a more comprehensive concept of measuring higher education quality.

References

[10] Yanova N. Assessment of Satisfaction with the Quality of Education: Customer Satisfaction Index. 4th World Conference on educational Technology Researches; Barcelona. 2014.


[17] ABET, Setting the standard worldwide, ed: ABET.

[18] Accreditation types and eligibility, ed: IABEE.

[19] Eligibility process and application, ed: AACSB.


Knowledge Level of Medicinal Plant Utilization and Conservation Efforts of Communities around Nature Conservation Areas in Central Sulawesi

Rosmaniar Gailea¹, R Nurdin², M. S. Nasrun³, Siiti Aminah⁴, A. T. Paramitha⁵
{gailearos@gmail.com}

Faculty of Agriculture, Universitas Muhammadiyah Palu, Jl.HangTuah No 114 Central Sulawesi 94118, Indonesia

Abstract. Central Sulawesi has Natural Conservation Areas (NCA). People who lived around the NCA certainly have local wisdom regarding their daily lives, including knowledge on the use of medicinal plants. This research aims to determine the level of local knowledge of the community based on its utilization and conservation aspects. The percentage of people over 40 years old 80% and people under 40 years old have the lowest knowledge level of 20. The method used was semi-structured interviews and direct observation of the community's existence of medicinal plants. Determination of respondents was conducted through purposive sampling. The number of respondents involved was 90 people, 30 in each village. The number of medicinal plant species obtained in the Poboya Village is 46 types, 57 types in Mataue Village, and 62 types in Bobo Village. The aspect of preservation of medicinal plants by the community is following the use of medicinal plants that they do that still have a sustainable nature, and this is indicated by the use of parts of medicinal plants, the highest utilization is leaves (61%), most of the habitus is herbs (54%), and The habitat where the medicinal plants are obtained is in the yard (59%).

Keywords: Knowledge, Medicinal Plant, utilization, Conservation

1 Introduction

Central Sulawesi Province is the largest province in Sulawesi Island, and forest covers approximately 64.60% of the total area of Central Sulawesi Province. Protected areas include Nature Reserve Areas and Nature Conservation Areas (land and waters), covering 676,248 hectares or (9.94%) of the total forest area [1]

The Nature Conservation Areas (NCA) in this study are the Lore Lindu National Park (LLNP) and the Forest Park (Taman Hutan Raya/Tahura) Palu. NCA is an area with specific characteristics. Both land and water have the primary function of protecting life support systems, preserving plant and animal diversity, and using biological natural resources and their ecosystems. [2]

People around The NCA, the LLNP, and Grand Forest Park Palu have lived there or generations, long before establishing these protected areas. The majority of the people around LLNP are the Kaili Tribe, the most significant indigenous in Central Sulawesi, Kaili Moma
(Kulawi), and the Pekurehua Tribe of Tara ethnic from Lore sub-district Poso District and other immigrant tribes such as the Bugis-Makassar, Toraja, Minahasa, Javanese. People around Forest Park Palu, in general, are the Kaili Tara Tribe / Sub-ethnicity and other tribes.

They have local wisdom in living their lives in general, one of which is through various types of plants that have been used for traditional medicine for generations. The community can do treatment of various types of diseases and health care using traditional plants. [3]

Previous studies have found that the recognition of indigenous, local, and traditional knowledge systems has increased knowledge of ecosystems, natural resources, and biodiversity [4]. From the knowledge and use of plants by the community, it can be seen that the aspects of preservation of these types of medicinal plants do not interfere the plant growth compared to using roots, for example when people tend to use more leaves than other plant parts to treat various types of diseases, stem or bark. However, the use of plant parts for traditional medicine also depends on natural conditions, the environment, and local natural resources availability.

Activities to explore or reveal local/traditional knowledge continue in several countries, not only in Indonesia. [5] The use of medicinal plants is essential in Southeast Asia, where biology and enormous cultural diversity illustrate the diversity of traditional medicine systems.

Based on these descriptions, it is necessary to conduct research on local community knowledge, utilization and conservation efforts that have been carried out. This research aims to determine the level of local knowledge of the community based on its utilization and conservation aspects.

2 Method

This research was conducted in Poboya, Mataue, and Petimbe. Poboya is an administrative area on the boundary of the Grand Forest Park of Palu, while Mataue and Petimbe are administrative areas located around Lore-Lindu National Park. The research was conducted in September 2017 - March 2018.

The selection of research areas was carried out purposively by considering the areas directly adjacent to the natural conservation areas. The materials and tools used in the study included a set of field tools for collecting herbarium specimens. medicinal plant specimens for herbarium collections, and questionnaire lists for the use of medicinal plants by the community.

The determination of the respondents to collect data on public knowledge about the use of traditional medicinal plants was done by purposive sampling by considering the age criteria of the people who used traditional medicinal plants. The criteria used in the age classification of the respondents consisted of people aged: 1) > 40 years old, and 2) <40 years old. The number of respondents in each village consisted of 30 people, so that overall in the study there were 90 respondents.

The data was collected through a semi-structured interview method using a questionnaire. Furthermore, based on the results of the interview, specimens of medicinal plants that have been used by the community were collected. Preparation of medicinal plant specimens is used for herbarium identification and collection. The identification of medicinal plant species was carried out at the Herbarium Celebense laboratory, Tadulako University.
Descriptive statistics are used for data analysis of observation parameters which include: 1) age of medicinal plant users, 2) number of medicinal plant species used by the community, 3) parts of plants used, 4) habitus, 5) habitat.

3 Result and Discussion

3.1. Nature Conservation Areas in Central Sulawesi

Forest Park of Central Sulawesi is one of the nature conservation areas (NCA) confirmed by Ministerial Decree No.24 / Kpts-II / 1999 covering an area of 7,128 ha, is an amalgamation of Poboya Nature Reserve, Paneki Protected Forest, and Kapopo Nature Park (the location of the National Green Week 30). Administratively, this includes Palu City and Donggala Regency; from the beginning, the management was carried out unilaterally of one side without involving other parties, including the community and customary institutions in/around the area.[6]

LLNP has essential meaning for protecting ecosystems and life support systems to the diversity of flora and fauna. Fauna, LLNP is also a source of livelihood for the surrounding community. [7] Furthermore, [8] stated that the motivation of people around LLNP is based on material needs. The motivation of the need for traditional medicines and wood to build materials and tools also classified as high.

Forest Park and the Lore Lindu National Park (LLNP) are The Nature Conservation Areas (NCA) in Central Sulawesi where the local life there came from various tribes/ethnicities, such as Kulawi and Pekurehua tribes but dominated by the Kaili Tribe, which has quite a lot of sub-ethnic groups and are indigenous tribes in Central Sulawesi.

3.2. Knowledge of Medicinal Plants

People in various parts of the world have used traditional knowledge through resources provided by nature to prevent, diagnose, treat health problems long before the development of pharmacy [9]

The people of Poboya, Mataue, and Petimbe Villages have almost the same knowledge of the types of medicinal plants and their benefits. In general, public knowledge about medicinal plants and traditional medicine comes from their parents who have been passed down from generation to generation; Healer generally has a higher level of knowledge than the general public. However, the percentage is not too different, as in Table 1.

<table>
<thead>
<tr>
<th>Level of Knowledge</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age ≥ 40</td>
<td>80</td>
</tr>
<tr>
<td>Age≤ 40</td>
<td>20</td>
</tr>
</tbody>
</table>
The level of knowledge and the utilization of medicinal plant species of people in Poboya Village is lower than people in Petimbe and Mataue Villages. Poboya Village is located around Forest Park Palu, as one of the NCA. Forest Park Palu has a relatively high biodiversity of lowland forest. In the last ten years, the Forest Park area, especially in the Poboya sub-district, has experienced quite heavy pressures on the environment due to gold mining.

In connection with the knowledge of medicinal plants and traditional medicine, people around LLNP (Mataue Village and Petimbe Village) still use various types of medicinal plants taken in gardens, yards, and harvest from the forest. This is in line with the results of Massiri's (2016) [8] that the motivation for the need for traditional medicines is classified as having high motivation in the community around LLNP.

The community around LLNP is maintaining and practicing knowledge of traditional medicine using ingredients from plants. Although it is suspected that there has been a shift in knowledge and the use of medicinal plants as an alternative to modern medicine and the improvement of health facilities from the government, the community has not entirely abandoned the treatment pattern.

Apart from the issue of modernization in medicine, in Malaysia, a modern generation who do not want to know or practice their ancestors' deeds is also the leading cause of the loss of practice and knowledge of traditional care today. [10]

A decrease in medicinal plants' use has also occurred in Kenya, Africa [11]. There has been a difference between knowledge and medicinal plants in the Marakwet community in Kenya; this shows the possibility of erosion of local wisdom in the community. In the Ngannawal and Yuin communities in Australia, knowledge of traditional food and medicinal plants still exists. However, the lack of involvement of young people is a problem in itself. [12]

3.3. Number of Types of Medicinal Plants Known to the Community

Until 2007, The Laboratory of Medicinal Plant Conservation, Faculty of Forestry, Bogor Agricultural Institute, has collected approximately 2039 species of medicinal plants originating from Indonesia forest. Therefore, Indonesia is one of the most important storehouses of biodiversity in the world [3].

Ethnobotany and ethnopharmacological studies have been carried out quite a lot, especially around the TNLL area [12-13-14]. There are 105 species of medicinal plants known and used in Peboya Village, Mataue Village, and Petimbe Village.

3.4. Preservation of Medicinal Plants according to their utilization by the community around the Nature Conservation Area

3.4.1. Part of medicinal plants used

Parts of medicinal plants widely used by the people around the NCA are leaves (61%), flowers (13%), fruit (96%), seeds (4%), stems (5%), roots (3), tubers (5%), whole plant (3%). Leaves are the most used ones. The use of leaves for traditional medicine is in three places, or 61%. The use of leaves as traditional medicine is relatively safer viewed through the preservation of medicinal plants because it does not interfere with plant growth compared to the use of other plant parts such as roots, stems, and bark. In general, leaves are part of the
plant that is mostly used by the people around LLNP [3-16-15]. Harvesting the roots and utilizing all parts of the plant will be more destructive than plant parts such as leaves, flowers, or buds. [17]

3.4.2. Habitus

Habitus or common forms of plants include trees (195), shrubs (95), bush (7%), lianas (7), and herbs (54%), most widely used by the community than other habitus. The use of herbal habitus as traditional medicine reaches 54% or 57 species. The aspect of preserving medicinal plants assumed that medicinal plant species from the herbal habitus are relatively safer than the tree or shrubs.

3.5. Preservation of Medicinal Plants by Communities around Nature Conservation Areas

The Lore Lindu National Park (LLNP) and Forest Park Palu have issues related to the surrounding communities' existence. These problems include population growth, which, of course, will affect the need for clothing, shelter, and food. This demand will undoubtedly encourage the community to carry out land clearing, encroachment, etc. It is likely that the life of biodiversity, including medicinal plants that grow in or around the NCA, will be threatened. A threat to the notable wild species, particularly for food and medicine, is the over-harvesting, habitat, and climate change.[18]. Communities around The Lore Lindu National Park (LLNP) (Petimbe Village and Mataue Village) are still collecting medicinal plants. This was also expressed by [8], that people around LLNP have a high demand for traditional medicines. Meanwhile, people in the Forest Park Palu Area (Poboya Urban Village), in which the opening of gold mining causes a reduction in biodiversity, including the bio-medicinal plants.

Medicinal plants are found in yards, gardens, forests, rice fields, swamps, wild (along roads, ditches, graves, etc.) in these three villages (Poboya Village, Mataue Village, and Petimbe Village). 62 species or 59% of medicinal plants are found living in the yard, and it is the place where most medicinal plants are found.

Table 2. The types of medicinal plants in the yard

<table>
<thead>
<tr>
<th>No</th>
<th>Scientific name</th>
<th>Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><em>Abelmoschus moschatus</em> L.</td>
<td>Malvaceae</td>
</tr>
<tr>
<td>2.</td>
<td><em>Abrus precatorius</em> L.</td>
<td>Papilionaceae</td>
</tr>
<tr>
<td>3.</td>
<td><em>Acalypha indica</em> L.</td>
<td>Verbenaceae</td>
</tr>
<tr>
<td>4.</td>
<td><em>Aglaia odorata</em> Lour</td>
<td>Euphorbiaceae</td>
</tr>
<tr>
<td>5.</td>
<td><em>Acalypha sp</em></td>
<td>Euphorbiaceae</td>
</tr>
<tr>
<td>6.</td>
<td><em>Alternanthera ficoides</em> R.B.</td>
<td>Amaranthaceae</td>
</tr>
<tr>
<td>7.</td>
<td><em>Aloe vera</em> (L.) Webb</td>
<td>Liliaceae</td>
</tr>
<tr>
<td>8.</td>
<td><em>Alpinia galangan</em> (L.) Swartz.</td>
<td>Zingiberaceae</td>
</tr>
<tr>
<td>9.</td>
<td><em>Alpinia sp</em></td>
<td>Zingiberaceae</td>
</tr>
<tr>
<td>10.</td>
<td><em>Amaranthus spinosus</em> L.</td>
<td>Amaranthaceae</td>
</tr>
<tr>
<td>11.</td>
<td><em>Andrographis paniculata</em> Burm. f.</td>
<td>Acanthaceae</td>
</tr>
<tr>
<td>12.</td>
<td><em>Andropogon nardus</em> L.</td>
<td>Poaceae</td>
</tr>
<tr>
<td>13.</td>
<td><em>Annona reticulate</em> L.</td>
<td>Annonaceae</td>
</tr>
<tr>
<td>No.</td>
<td>Scientific Name</td>
<td>Family</td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>14</td>
<td>Arcegalis flava L.(Merr.)</td>
<td>Menispermaceae</td>
</tr>
<tr>
<td>15</td>
<td>Areca catechu L.</td>
<td>Areaceae</td>
</tr>
<tr>
<td>16</td>
<td>Areca sp.</td>
<td>Areaceae</td>
</tr>
<tr>
<td>17</td>
<td>Areca vestiaria Giseke</td>
<td>Arecaceae</td>
</tr>
<tr>
<td>18</td>
<td>Artemisia vulgaris L.</td>
<td>Asteraceae</td>
</tr>
<tr>
<td>19</td>
<td>Arthocarpus communis J.R.&amp; G.Frost.</td>
<td>Moraceae</td>
</tr>
<tr>
<td>20</td>
<td>Arthocarpus heterophylla Lamk.</td>
<td>Moraceae</td>
</tr>
<tr>
<td>21</td>
<td>Averrhoa bilimbi L.</td>
<td>Oxalidaceae</td>
</tr>
<tr>
<td>22</td>
<td>Blumea balsaminifera (L) DC</td>
<td>Asteraceae</td>
</tr>
<tr>
<td>23</td>
<td>Biophytum reinwardtii (Zuec.) Klotsch.</td>
<td>Oxalidaceae</td>
</tr>
<tr>
<td>24</td>
<td>Centella asiatica Urb.</td>
<td>Umbelliferae</td>
</tr>
<tr>
<td>25</td>
<td>Citrus aurantifolia (Christm &amp;Panz) Swingle</td>
<td>Rutaceae</td>
</tr>
<tr>
<td>26</td>
<td>Clerodendrum calamitosum L.</td>
<td>Verbenaceae</td>
</tr>
<tr>
<td>27</td>
<td>Cinnamomum zeylanicum Bl.</td>
<td>Lauraceae</td>
</tr>
<tr>
<td>28</td>
<td>Cirrus aurantifolia Swingle</td>
<td>Rutaceae</td>
</tr>
<tr>
<td>29</td>
<td>Coleus scutellarioides Bth.</td>
<td>Lamiaceae</td>
</tr>
<tr>
<td>30</td>
<td>Curcuma aeroginosa Swingle</td>
<td>Zingiberaceae</td>
</tr>
<tr>
<td>31</td>
<td>Curcuma xanthorrhiza</td>
<td>Zingiberaceae</td>
</tr>
<tr>
<td>32</td>
<td>Curcuma zedoaria Roxb.</td>
<td>Zingiberaceae</td>
</tr>
<tr>
<td>33</td>
<td>Cyperus rotundus L.</td>
<td>Graminaceae</td>
</tr>
<tr>
<td>34</td>
<td>Dysophylla auricularia (L) Blume</td>
<td>Lamiaceae</td>
</tr>
<tr>
<td>35</td>
<td>Erigeron sumatranensis Retz</td>
<td>Asteraceae</td>
</tr>
<tr>
<td>36</td>
<td>Euphorbia hirta L.</td>
<td>Euphorbiaceae</td>
</tr>
<tr>
<td>37</td>
<td>Gynura procumbens</td>
<td>Compositae</td>
</tr>
<tr>
<td>38</td>
<td>Grapthophyllum pictum Griff.</td>
<td>Rubiaceae</td>
</tr>
<tr>
<td>39</td>
<td>Helianthus annum L.</td>
<td>Asteraceae</td>
</tr>
<tr>
<td>40</td>
<td>Heliconia indica Lamk.</td>
<td>Heliconiaceae</td>
</tr>
<tr>
<td>41</td>
<td>Ipomea reptaans Poir</td>
<td>Convolvulaceae</td>
</tr>
<tr>
<td>42</td>
<td>Jatropha curcas L.</td>
<td>Euphorbiaceae</td>
</tr>
<tr>
<td>43</td>
<td>Jatropha multifida L.</td>
<td>Euphorbiaceae</td>
</tr>
<tr>
<td>44</td>
<td>Justicia gandarussa Burm f.</td>
<td>Acanthaceae</td>
</tr>
<tr>
<td>45</td>
<td>Kalanchoe pinnata Pers.</td>
<td>Crassulaceae</td>
</tr>
<tr>
<td>46</td>
<td>Lannea coromandeica (Houtt.) Merr.</td>
<td>Anacardiaceae</td>
</tr>
<tr>
<td>47</td>
<td>Moringa oleifera Lamk.</td>
<td>Moringaceae</td>
</tr>
<tr>
<td>48</td>
<td>Ocimum basilicum L.</td>
<td>Lamiaceae</td>
</tr>
<tr>
<td>49</td>
<td>Orthosiphon spicatus BBS.</td>
<td>Labiatae</td>
</tr>
<tr>
<td>50</td>
<td>Pedilanthus tithymaloides (L.) Poit</td>
<td>Euphorbiaceae</td>
</tr>
<tr>
<td>51</td>
<td>Piper betle L.</td>
<td>Piperaceae</td>
</tr>
<tr>
<td>52</td>
<td>Plantago mayor L.</td>
<td>Plantaginaceae</td>
</tr>
<tr>
<td>53</td>
<td>Punica gratum L.</td>
<td>Punicaceae</td>
</tr>
<tr>
<td>54</td>
<td>Phyllanthus urinaria L.</td>
<td>Euphorbiaceae</td>
</tr>
<tr>
<td>55</td>
<td>Ricinus communis L.</td>
<td>Euphorbiaceae</td>
</tr>
<tr>
<td>56</td>
<td>Sigesbeckia orientalis L.</td>
<td>Crassulaceae</td>
</tr>
<tr>
<td>57</td>
<td>Svernonia cinerea Sw.</td>
<td>Asteraceae</td>
</tr>
<tr>
<td>58</td>
<td>Tabernaemontana pandacaqui Poir.</td>
<td>Apocynaceae</td>
</tr>
<tr>
<td>59</td>
<td>Tinospora crispa (L.) Miers.</td>
<td>Menispermacceae</td>
</tr>
<tr>
<td>60</td>
<td>Tridax procumbens L.</td>
<td>Asteraceae</td>
</tr>
<tr>
<td>61</td>
<td>Zingiber cassumunar Roxb.</td>
<td>Zingiberaceae</td>
</tr>
</tbody>
</table>
The medicinal plants in the yard grow by people to take them quickly when the medicinal plants are needed. Meanwhile, Cultivation efforts on a broader scale have not been carried out. The preservation of medicinal plant species by the community in their yards is a first step in preserving medicinal plants both around LLNP and around Forest Park Palu.

There are 6 species of plants in Table 1 that grow in forests and are rarely found, these plants are *Alpinia* sp, *Archangelisia flava* (L.) Merr., *Areca* sp, *Areca vestiaria* Giseke, *Graphtophyllum pictum* Griff., *Tinospora crispha* (L.) Miers.

### 4 Conclusion

The communities around The Lore Lindu National Park (LLNP) and Grand Forest Park conversant about medicinal plants for traditional medicine. The percentage of people over 40 years old 80% and people under 40 years old have the lowest knowledge level of 20. There are 105 medicinal plants used by the community in the study area. The parts of medicinal plants that are widely used by the community consecutively include: leaves (61%), flowers (13%), fruit (6%), seeds (4%), stem (5%), root (3%), tuber (5%) and whole plant (3%). The habitus of medicinal plants that are most widely used by the community, respectively, include: herb (54%), shrub (9%), bush (7%), tree (19%). The dominant medicinal plant habitats used by the community are in the house yard (59%), forest (19%), rice fields (9%), swamps (4%). The efforts to conserve medicinal plants that have been carried out by the community ex-situ include *Alpinia* sp, *Archangelisia flava* (L.) Merr., *Areca* sp, *Areca vestiaria* Giseke, *Graphtophyllum pictum* Griff., *Tinospora crispha* (L.) Miers.

### References


Heaney E, Sutherland S, Bell T, Unit IH. KNOWLEDGE AND USE OF TRADITIONAL PLANTS BY NGUNNAWAL AND YUIN PEOPLE OF AUSTRALIA: BARRIERS TO KNOWLEDGE AND TRANSMISSION. 2020;1(July 2019):52–95.


Straight Motion: A Mobile Application for Learning Linear Motion

Elisabeth Pratidhina¹, Ferina Rizky Yuliani², Johannes V D Wirjawan³, Herwinarso⁴, Budijanto Untung⁵
{elisa.founda@ukwms.ac.id¹, ferina.rizky@gmail.com², wirjawan@ukwms.ac.id³, herwinarso@ukwms.ac.id⁴, budijanto@ukwms.ac.id⁵}
Department of Physics Education, Widya Mandala Surabaya Catholic University, Jl Kalijudan 37 Surabaya, Indonesia, 60114¹,2,3,4,5

Abstract. Mobile phone technology has been developed tremendously in the last two decades. The smartphone's emergence has shifted the primary function of a mobile phone because it provides various advanced features. Multiple features in the smartphone are the potential to be utilized in education. In this paper, we report a study that aims to develop a Straight Motion application, a mobile application designed as a learning resource on linear motion topics. The application is targeted to high school students as a resource for pre-lecture preparation or post-lecture review and individual study. Straight Motion application is evaluated by an expert in physics and physics education. According to the evaluation, the application is feasible to be used by high school students in learning physics. We also conduct field testing, which involves 63-grade 10th students. To investigate the learning improvement, we give pre- and post-test to students before and after they use Straight Motion for learning linear motion. The calculated normalized gain is 0.56, which can be classified as medium gain. Moreover, students also give an excellent response to the use of Straight Motion in the learning process.

Keywords: high school physics, learning media, mobile app

1 Introduction

One of the vast developed technology is the mobile phone. Nowadays, the mobile phone's primary function as a communication device has been shifted with smartphone emergence. In current society, the smartphone is one of the essential technology used by people around the world. Smartphone typically has a touch screen, internet access, and the capability to install applications, cameras, media players, sensors, and navigation function [1]. The smartphone can be regarded as a pocket computer.

Advanced technology in mobile devices, including smartphones, evokes educators, and researchers to promote teaching and learning [2-4]. Mobile devices can make the classroom more interactive and engaging [5,6]. Several studies indicate that mobile learning is motivating for students [7,8]. Mobile devices can also be used to achieve anytime, anywhere, and ubiquitous learning [9]. With mobile devices, teaching and learning are not restricted by time and place. Students can extend their learning activity at a home where learning can occur naturally [10].

There has been an excessive attempt to include smartphones in the learning activity, including in physics disciplines. Physics educators have used smartphones to engage students...
in a physics experiment class [11-13]. Smartphones have various sensors that can be used for precise measurement tools such as magnetometer [14], accelerometer [15], gyroscope [12], and light sensor [16]. Using a smartphone in a physics experiment is the potential to build meaningful learning for students.

Smartphone has the capability for installation of applications. Educators can build applications as multimedia in learning physics [17,18]. Multimedia can foster learning physics’s effectiveness because it can present visualizations of physical concepts and related examples of physical phenomena. Also, educators can include physics simulation in smartphone application [19-21]. Simulation has some advantages, such as allow students to experience indirect-data collection and analysis, support visualization of conceptual entities, and develop students' critical thinking through the inquiry process at public places and time. Some researchers also develop educational games in the mobile application to gain students' interest and motivation in learning physics [22-24].

Young learners are familiar with digital technology. They are often called digital natives. They are known as digitally literate, connected multitasker, and discovery learners [25]. The smartphone may create a flexible and personalized learning process suitable for young learners like high school students. In this study, we design smartphone applications as a learning resource for high school students. We name it "Straight Motion." Straight Motion application aims to help students in learning Linear Motion. We combine multimedia and simulation in one application. Straightforward Motion application includes material, simulation, and problem exercise. Students can use the application as a resource for pre-lecture preparation or post-lecture review and individual study.

2 Method

This research aims to develop Straight Motion as a learning media on the topics of linear motion. The study is started with need assessment and analysis of the characteristic of learners and curriculum. The targeted learner is high school students in grade 10 who are mostly digital native and familiar with smartphone technology. We design the learning resource according to National Curriculum in Indonesia.

We construct the material based on the learner, need, and curriculum analysis. In brief, the concept map of the designed material is shown in Figure 1. We create the prototype of the Straight Motion application in the Adobe Animate CC software [26].

After we construct the Straight Motion prototype, the next step is a series of developmental testing. In developmental testing, the prototype of the Straight Motion is evaluated through expert appraisal and field testing. A revision follows each step of developmental testing. The expert appraisal involves experts in physics and physics education, both lecturers in the Department of Physics Education.

We carry out a pilot study in a private high school in Indonesia to implement the developed application and investigate its impact on students' learning achievement. Sixty-three students in grade 10 participate in the pilot study. Pre- and post-test are conducted before and after the participants learn linear motion with the application. The comparison between the results of both tests is used to determine the learning improvement. We use normalized gain score \( g \) as the parameter of the students’ learning improvement. The formula to calculate \( g \) is:

\[
\langle g \rangle = \frac{\% (S_f) - \% (S_i)}{100 - \% (S_i)}
\]  

(1)
where $\langle S_i \rangle$ and $\langle S_f \rangle$ are pre-and post-test class averages, respectively. Hake (1998) divides $(g)$ into three categories, i.e., high for $(g) \geq 0.7$; medium for $0.7 > (g) \geq 0.3$, and low for $(g) < 0.3$. After using the application, students also fill a questionnaire about their opinion on the developed application. They also write their suggestion to improve the quality of the application.

---

3 **Result and Discussion**

The Straight Motion application has three main features, i.e., material, simulation, and problem exercise, such as presented on the homepage of the application (see Figure 2). The material discusses quantities in kinematics, uniform, and non-uniform linear motion with constant acceleration. Examples of linear motion in real physical phenomena such as vertical motion and free-falling are also discussed. We explain linear motion characteristics through various physical representations, such as verbal explanation, mathematical expression, and graph. Moreover, illustration and animation are also inserted. Screenshots of the material menu are presented in Figure 3.
Fig 2. The screenshot of the homepage
This Straight Motion is also accommodating the Simulation menu. The simulation aims to give students experience in investigating the characteristics of some types of linear motion. There are three simulations in this application. They are about a car that moves with constant velocity, a vehicle that moves with constant acceleration, and a free-falling stone. In investigating the characteristic of uniform linear motion, students are asked to do the simulation with a car (see Figure 4). In the simulation, students can vary the moving distance of a vehicle.
up to five times. The time required by the car will be shown up, and students need to write down the time for the respective moving distance. Students are asked to plot a graph between space and time and compare it to the mathematical expression. Students are guided to find the relation among physical quantities in various types of linear motion through simulation.

For individual learning activities, students should be able to do self-evaluation of their studies. Thus, the Straight Motion application also provides problem exercise, as illustrated in Figure 5. In this menu, students can answer some multiple-choice questions and get feedback directly.
3.1 Developmental Testing

Experts in physics and physics education evaluate the prototype of the Straight Motion application. The experts give several ideas to make the prototype becomes better. We accommodate some of those ideas in the revision process. After a couple of revisions, overall experts provide an excellent rating in content, instructional, layout, language, and accessibility (see Table 1).

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Score*</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material/Content</td>
<td>3.89</td>
<td>Excellent</td>
</tr>
<tr>
<td>Instructional</td>
<td>3.72</td>
<td>Excellent</td>
</tr>
<tr>
<td>Layout quality</td>
<td>3.57</td>
<td>Excellent</td>
</tr>
<tr>
<td>Accessibility</td>
<td>3.36</td>
<td>Excellent</td>
</tr>
<tr>
<td>Language</td>
<td>3.66</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

* max score: 4.0

We carry out field testing in an Indonesian private high school. We calculate the N-gain score with the formula in equation (1) to determine the students' learning improvement. Figure 6 shows the comparison between average pre-and post-test scores. The average N-gain score is 0.56 (see Table 2), which can be interpreted as a medium improvement [27].
Although in this research, we have not compared our applied learning method with others, the current result aligns with previous studies that emphasize the advantage of using multimedia, especially mobile learning applications in physics learning [19,28]. Multimedia enable students to get information in more various formats. Through visualization in multimedia, physical concepts can be presented in a more informative way to students.

![Graph](image.png)

**Fig 6. Result of pre-and post-test**

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Average Score</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>3.23</td>
<td>Good</td>
</tr>
<tr>
<td>Instructional</td>
<td>3.31</td>
<td>Good</td>
</tr>
<tr>
<td>Layout quality</td>
<td>3.31</td>
<td>Good</td>
</tr>
<tr>
<td>Accessibility</td>
<td>3.30</td>
<td>Good</td>
</tr>
</tbody>
</table>

**Table 2. The comparison between the pre-and post-test score**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Average Pre-Test</th>
<th>Average Post-Test</th>
<th>Normalized Gain Score, (&lt;g&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>medium</td>
<td>6.30</td>
<td>58.81</td>
<td>0.56</td>
</tr>
</tbody>
</table>

During the field testing, we give a questionnaire to students. As shown in Table 3, students provide an excellent response to every straight motion aspect. Students provide fantastic reactions to the clarity of the material. From the instructional element, the application is also useful. It is helpful for students in understanding the concepts of linear motion. The layout of the application has a good quality. Moreover, accessibility is also good. There is no frequent bugging while opening the application.
4 Conclusion

In summary, we have developed Straight Motion, an Android-based learning application on Linear Motion topics. Based on the experts' evaluation, the learning resource helps students learn the linear motion. Besides, field testing indicates students' learning improvement after using Straight as a learning resource. A good response is given to the use of Straight Motion applications. The mobile-based learning resource is convenient and helpful for students. This study still has some limitations. The investigated learning improvement in this study only covers the cognitive domain. For further research, we need to consider the affective and psychomotor domains. Moreover, field testing may be improved by using experimental and control classes.

Acknowledgments. This study is supported by the Indonesian Ministry of Education and Culture under the PTUPT grant with contract number: 130V/WM1.5/N/2020.

References


Emergency School Learning Model with Disaster Management in Post-Earthquake Areas in Palu City

Normawati¹, Muhammad Rizal Masdul², Mansur³, Nuranisa⁴

{normawati96@yahoo.com¹, rizal.masdul@gmail.com², mansur20jan@gmail.com³, nonaanisa51@gmail.com⁴}

Faculty of Islamic Religion, Islamic Education, Universitas Muhammadiyah Palu, Central Sulawesi 94118, Indonesia

Abstract. This research intends to: First, develop the learning of early detection and disaster risk integrated into subjects in elementary schools in disaster areas. Second, design teaching and learning strategies through a fun learning approach to increase mental resilience and learning motivation students post the disaster. Third, develop simulation learning media (audiovisual) that are recreational for students in disaster areas. The research and development with a spiral model that adapts the five phases of instructional design. The population was all elementary school students in post-disaster areas in Palu City. The sample was taken through stratified random sampling that selected two elementary schools, each of which is located in areas with the potential for tectonic earthquakes in Palu City, namely SDN Balaroa and SDN Petobo, the red zone prone to earthquakes and have the potential to be affected by liquefaction. The results of the research have been able to develop learning tools as follows; (1) special practicum kits, (2) lesson plans, (3) student activity sheets (LKS), and (4) evaluation instruments. Students have examined these learning tools at SDN Balaroa and SDN Petobo. This is following the specific objectives of this research to produce fun learning based on learning modules and develop teaching and learning strategies with a fun learning approach, to increase mental resilience and learning motivation to post-disaster students, which is then accompanied by the realization of the research objectives, namely, developing the learning of early detection and disaster risk integrated into science subjects in primary schools in disaster areas.

Keywords: Learning Model, Fun learning approach, and post-disaster learning

1 Introduction

Indonesia is a country rich in natural resources. However, behind this wealth, Indonesia is a disaster storefront. Following their geographic conditions, almost all regions in Indonesia are in risky areas for natural disasters. This means that disaster preparedness is urgently needed. Disaster often occurs in recent years and is no longer a foreign word to us. Almost every season, even every month, their disaster occur. The definition of tragedy varies. According to Setyowati, disaster is an activity impact or risk that harms humans [1].

One of the impacts is very much felt in the field of education. Students experience difficulties both mentally, psychologically, and physically with the destruction or damage of school learning facilities. Disasters also often have lasting consequences for children. The
destruction of educational infrastructure due to the disaster caused the lost opportunity for children to participate in educational activities. Educational activities were then held in emergency schools. This condition lasts a long time in many disastrous events. This situation is less favourable for children who have to study with limited facilities, which in the end, the teaching and learning process cannot take place optimally.

The legal framework for overcoming this has been mandated in the 1945 Constitution Article 31 paragraph 1. It states that every citizen has the same opportunity to obtain an education. Likewise, in the National Education System Law Number 20 of 2003, the eleventh part of article 32 states about the government's obligation to provide special education for those who experience learning difficulties, especially after a general disaster and in disadvantaged areas in particular [2]. It is deemed necessary to prepare a disaster preparedness method in an emergency school that emphasizes an interesting learning approach in terms of affective cognitive and psychomotor. This is an effort to rehabilitate students' psychological conditions. Considering emergency conditions where many learning tools were damaged, a simple, attractive learning media was created, specifically for handling education in post-disaster areas.

This research intends to introduce students to situations and problems that occur before and post-disaster; therefore, they are expected to learn to survive, accept, and face it. The researcher is interested in taking the Emergency School Learning Model theme through Fun Learning Approach in Problems were diagnosed for the first time to determine issues in the learning process post-natural disaster in emergency schools. The initial hypotheses of problems that exist post-natural tragedy are based on this research results when the researcher visits areas affected by the earthquake and regions after the earthquake and liquefaction in Palu City.

Data were collected through discussions with teachers and school authorities. Their hypothesis is: How is Emergency School Learning in post-disaster areas, especially disadvantaged areas through a Fun Learning Approach in Post-Disaster Areas?. This research's general purpose is a practical effort to evaluate the sustainability of education during disaster emergency response and disadvantaged areas for children in post-disaster schools.

The specific objectives of this research are: To motivate students who lived in post-disaster areas, especially disadvantaged areas, to keep learning even in post-disaster situations. To Evaluate the sustainability of the teaching and learning process (education) with a variety of methods, approaches, and learning media that can improve mental resilience and motivation to learn post-disaster both in terms of knowledge, attitudes, and skills. Practically this research intends to help the emergency school learning model with a fun learning approach in post-disaster areas

Previous research discusses Learning Models in Emergency Schools for Mount Merapi Disaster Victims in Sleman Regency, Yogyakarta Special Province. The catastrophic eruption of Mount Merapi on the border of Central Java Province and Yogyakarta Special Region is a natural occurrence that has resulted in the destruction of various public facilities and infrastructure including schools [3]. There is also research on post-disaster emergency classes
for elementary students by offering the concept of non-formal education. It consists of two modules, namely the classroom module, which accommodates teaching and learning functions, and multimedia fun learning [4]

2 Method

This qualitative research produces descriptive data in the form of writing about people or people's words and their visible behavior. The use of this method is seen as a "research procedure" that is expected to produce descriptive data in the form of written or spoken words from a number of people and observed their behaviour [5]. Qualitative research methods are often called natural research methods because the research is carried out in natural conditions (natural setting); it is also called the ethnographic approach because initially this method is more widely used for research in the field of cultural anthropology; referred to as a qualitative method because the data collection and data analysis are more of a qualitative nature [6].

This research was conducted in an emergency school located in Palu City, Central Sulawesi Province, in the areas affected by the Earthquake, Liquefaction, and Tsunami on September 28, 2018.

3 Results and Discussion

3.1 General Description of Refugee Areas

The earthquake occurred forced all residents in disaster areas to evacuate to a safer place. Many children of school age move with their parents or family. In addition, many children lost their parents and families, so they try to save themselves to a safer place. Children have to bear a heavy psychological burden in an effort to save themselves from the threat of disaster and heavy-duty of life due to the loss of their family and loved ones; this causes them not willing to participate in learning activities at refugee camps. In this connection, various efforts by adults are needed to motivate children, and they are expected to be more passionate about carrying out daily activities, including learning activities.

The government in Palu city conveys the message to parents in refugee areas to keep their children studying according to their education level. The government organized emergency schools located at SDN Balara and SDN Petobo located close in order for the learning activities to be conducted. In a book of "Disaster Management" [7]. Prevention activities are divided into 2, namely: First is prevention in passive mitigation. This activity includes drafting laws and regulations, making disaster-risk maps and mapping problems, making procedure guidelines, conducting research related to disasters, assessment, disaster risk analysis, the establishment of disaster response organizations and strengthening social units in the community, and prevention in active mitigation.
These activities include the creation and placement of danger warning signs, the prohibition of entering disaster-risk areas, monitoring the implementation of various spatial planning regulations, relocating residents from disaster-risk areas to safer places, creating evacuation routes, and building structures in accordance with the established building standards. Second, disaster preparedness can be defined as a state of readiness in the face of a crisis. Preparedness can be carried out by pro-active activities in planning actions to respond to disasters. The International of Red Cross and Red Crescent Society (IFRC) explains that preparedness is a continuous and integrated process resulting from a variety of risk and resource reduction activities. Disaster preparedness provides a program to design practical, realistic, and coordinated plans with risk reduction measures, prevent disaster situations, save maximum lives and return the community back to normal functions in a short time [8].

Disaster response is an activity during a disaster that involves multi-agency coordination in responding to disasters. This activity is held to reduce the impact of disasters. Activities in disaster response include quickly studying the location, damage, and resources, determining the status of a disaster emergency, providing emergency health services and evacuating or rescuing people affected by disasters, meeting basic needs, and protecting vulnerable groups—fourth; Recovery (Recovery). The Asian Disaster Preparedness Center (ADPC) explained that recovery is an activity after emergency needs have been met, and the initial crisis ends. Important components during the recovery process include agreement on institutional arrangements, coordination, and communication between institutions, monitoring, and evaluation until conditions in the surrounding community return to normal in long-term development project planning. This activity can be supported by conducting an assessment of the needs of the affected communities prior to the development project. The stages in the recovery phase are divided into two stages, namely as follows.

The first stage is Rehabilitation. Recovery is to improve the condition of the affected area, which is uncertain to a better normal state. Therefore people's lives can return to normal. These activities can be carried out through rebuilding the disaster area, repairing public facilities and infrastructure, providing assistance to repair houses in the community, socio-psychological recovery, continued health care, conflict resolution, socio-economic and cultural healing, as well as restoration of security and order.

The second stage is Reconstruction: Reconstruction is the stage of rebuilding facilities and infrastructure damaged by the disaster. Activities carried out at the reconstruction stage are the reconstruction of facilities and infrastructure, reconstruction of community social facilities, restoring the life of the socio-cultural community, using good designs and disaster-resistant equipment, improving public service functions, and improving essential services in the community. This activity should be carried out through planning, preceded by an assessment of various experts and sectors related to the findings of the meeting. This is indicated by decreasing low values (1 and 2) and increasing high scores (4 and 5).

3.2 Emergency School
SDN Balaroa, as an emergency school, has a reasonably large location. Apart from the principal's room, the teacher's room, the principal's official residence, and 12 classrooms, SDN
Pangukan also has a hall, an art room, a library room, and a prayer room. With the availability of various room facilities at SDN Balaroa, in general, the policy of organizing this emergency school does not interfere with the teaching and learning activities of regular SDN Balaroa students because they can still study as usual by occupying their respective classrooms. Meanwhile, the learning space for refugee children in the library, art room, hall, prayer room, and the terrace of SDN Balaroa.

3.3 Students
There were 208 children who participated in the learning activities in the emergency school, consisting of 107 boys and 101 girls—parents and children who took refuge in various areas of Palu city, which are safe areas from disasters.

3.4 Infrastructure
Facilities and infrastructure owned by the emergency schools at SDN Balaroa and SDN Petobo are quite adequate compared to emergency schools located in tents or other evacuation locations. This is because SDN Balaroa and SDN Petobo themselves have sufficient facilities and infrastructure; this meets their needs for learning activities; facilities available are excellent and comfortable buildings, tables and chairs, blackboards, chalk, erasers, library books, and mats. In order to fulfill adequate facilities and infrastructure, the locations of SDN Balaroa and SDN Petobo are easily accessible by public transportation; it is more comfortable to distribute assistance for learning activities such as elementary school uniforms, learning resources, learning media, and their utilization facilities and stationery.

Many institutions have participated in the implementation of emergency schools, both government and private institutions, such as the Indonesian Ministry of Education and Culture and the Palu branch of the Indonesian Red Cross (PMI). Many assistance was provided, material, and non-material. At the handover and signing event, the learning media assistance from the Head of the Palu City Education, Youth and Sports Office responded because it was beneficial and it motivates students to participate in learning activities in emergency schools. Furthermore, the Head of the Education Office emphasized that the volunteer teacher's level up the use of available learning media [9].

The existence of transition schools is an option to accelerate education recovery in Central Sulawesi post-disaster on September 28, 2018. The semi-permanent school building can be used for teaching and learning activities while awaiting the rebuilding of a permanent school building by the government during the Rehabilitation and Reconstruction of Central Sulawesi for the next two years.

Edhie Sarwono, Director of United Tractors, in his statement to journalists after the closing ceremony of the United Tractors Group Humanitarian Program for Palu, Sigi, and Donggala, said that the transitional school building facilities are expected to accelerate the recovery of education in Central Sulawesi. He said the transitional school building can be used for teaching and learning activities within two years while waiting for the construction of a permanent school construct by the government [10]. Ten schools they build support 155 educators and 1,025 students. We want more, but in the meantime, that is what the best.
Furthermore, many students can be covered to recover their enthusiasm to gain knowledge and build better character, "he explained.

Marlina Aliman, the principal of SDN 1 Petobo, told VOA that even though it is not a permanent school, the construction of a transitional primary school is significant for teachers and students who have spent a long time studying in an emergency tent. Before United Tractors' assistance, we learned from the emergency tents provided by the Ministry of Education and Culture. We studied there. There were five schools in one tent, consisting of three public schools and two private schools. Marlina, from SDN 1 Petobo, was affected by liquefaction in the earthquake on September 28, 2018. Besides that, one teacher and seven students died in the incident. She said that for a long time, teaching and learning activities had to be conducted in emergency tents. He reported that after the disaster, the number of students at his school, which previously only 232, had decreased to 162 students. According to him, this was because many children go to the shelter with their parents. He hopes that during the rehabilitation and reconstruction period of Central Sulawesi after the natural disaster, which lasted for two years, the government can provide land for the reconstruction of permanent school buildings. Marlina, The most important thing from the government is to prepare a location to build a permanent school because until now they are still carrying out teaching and learning activities in emergency schools and really expect the government's attention to build a permanent school as soon as possible, so that the learning process will run smoothly again.

Ansar Sutiadi, Head of the Education and Culture Office of Palu City, said that his party had made efforts to make improvements in elementary and junior high school (SMP) buildings involving support from the Ministry of Education and Culture, NGOs, and the private sector which for now is prioritizing badly damaged schools. He said that the general repair of school buildings that were heavily, moderately, and lightly damaged in Palu City would take two years. According to Ansyar Sutiadi, repairs due to the damage have begun to be repaired, assistance from the Ministry of Education and Culture, assistance from NGOs, assistance from the private sector, others are still waiting, but we will prioritize schools that are badly affected and are targeted for completion of 2 years. Ansar Sutiadi added that currently, 15 transitional or semi-permanent schools had been built in affected areas such as in Balaroa and Petobo. Hopefully, all children may attend school. Even though the facilities are still minimal, at least teaching and learning activities have been held in these transition schools.

3.5 Learning Management in Emergency School

Learning activities in emergency schools are the same as learning activities held in traditional schools in general, except for the total learning time, which lasts 3 (three) hours (starting at 07.00-10.00 WITA). Even though volunteer teachers are urged to continue learning activities according to the schedule and time allocation in schools in general, in practice, students are already tired of attending lessons when the time is late due to the scorching conditions in the emergency school.

Students argued that every night the atmosphere in the evacuation area was boisterous. It disturbs their rest time. Therefore, every 10.00 WITA, they start to feel sleepy, so they ask that
the learning activity should be ended. Thus, volunteer teachers were forced to end learning activities at 10.00 WITA.

According to the volunteer teachers who were respondents, at first, it was difficult for refugee children to attend school. The volunteer teachers patiently persuaded the children to go to school to study. Even further, they pick them up and coax them at the refugee camp every morning. Thanks to the patience and persistence of the volunteer teachers, the students gradually showed changes and began to be inspired to attend emergency schools regularly. Changes in the attitudes of students started to appear when students took part in learning activities that use learning media (A.M, 2016)

Teachers are equipped with knowledge and skills and learning media to manage learning activities in emergency schools. The literal meaning of media is the plural form of the word médium. Media is an intermediary or introduction, in other words, namely as an intermediary that delivers information between the source and the recipient [11].

The use of instructional media is one of the alternative solutions to overcome the difficulties/limitations of implementing learning activities because one of the main functions of learning media is as a teaching aid that also influences the climatic conditions and learning environment that are arranged and created by the teacher [12]. It is further argued that the use of instructional media in the teaching and learning process can generate new desires and interests, generate motivation and stimulation of learning activities, and even bring psychological influences on students. One form or type of learning media is Video Compact Disk (VCD). The definition of VCD is a digital standard format for storing video on a compact disc (compact disc). VCD are types of digital optical discs that are used to store data and are portable or can be carried anywhere [13].

The volunteer teachers no longer fully use the lecture method but learning media. After completing the use of learning media, the volunteer teacher (a) provides additional explanations, (b) provides opportunities for students to ask questions or express their opinions on the subject matter that is broadcast through learning VCD media, (c) organize discussion activities. At last, volunteer teachers provide questions about the subject matter discussed to be worked on but only when time is available.

Students are grouped according to their level or class and accompanied by two volunteer teachers. Volunteer teachers who teach in emergency schools are assigned by the Palu City Youth and Sports Education Office. Each elementary school in Palu City that is not affected by the earthquake and liquefaction is required to send one volunteer teacher to teach at an emergency school. Thus, volunteer teachers are basically teachers who teach in regular schools who are temporarily assigned to teach in emergency schools.

3.6 Learning Model in Emergency School

3.6.1 Changes in Student Behaviour during Learning Activities

The unavailability of books in emergency schools is not an obstacle because learning media and media presentation equipment is used, teachers can display subject matter derived from electronic school books (BSE) and learning videos containing subject matter for
elementary students. Students are brought to know the environment, interact, identify objects in the form of images with uniformity of observation so that children can arise new desires and interests, and are motivated to keep learning. [14] .

Children begin to show feelings of motivation and pleasure to go to school to participate in learning activities due to VCD's use as learning media. Even children who feel they only provided less time to take part in learning activities as they think interested and happy with the learning videos. Changes in children's attitudes that occur can be due to the impact/influence of the used learning media, which has been proven to have several potentials and strengths.

Each student's experience is different, depending on the factors that determine the richness of his experiences, such as the availability of books that can be easily reached and the family or community environment who likes to read. Learning media can overcome various limitations exist. Multiple objects that are difficult to show to students to be discussed/studied can be packaged, either in a tangible form, miniature, models, or in the form of images and can be presented in audiovisual format.

There are many objects that students cannot experience directly in the classroom, among others, because: (a) the thing is too big; (b) the item is too small; (c) the object is moving too slowly; (d) the thing is moving too fast; (e) the object is too complicated; (f) the item sounds too delicate, or (f) dangerous objects with high risk. All of these objects can be presented to learners through the use of appropriate media. The benefits obtained from these activities are:

- Allow direct interaction between students and their environment.
- It is generating uniformity of observations.
- It is embedding basic concepts that are correct, concrete, and realistic.
- They are generating new desires and interests.
- Generating motivation and stimulating children to learn.
- Providing an integral/comprehensive experience from the concrete to the abstract

The behavior of students from unwilling at the beginning or less interested in coming to the emergency school, and even having to be persuaded and invited now change into students who are motivated to study in emergency schools at SDN Balaroa and SDN Petobo. The changes shown by these students were seen after they participated in learning activities using learning media. 36 (90%) of students stated that they were happy with learning activities using teaching media. They said the subject presented was interesting, not dull, and straightforward, so it is easier to understand. Only 8 (20%) students said they did not like learning activities through learning media because the presentation and explanation of subject matter are fast that they cannot fully follow or understand.

3.6.2 Benefits of the application of learning activities using VCD as learning media

The Pustekkom Kemdikbud not only provides learning media in the form of electronic school books (BSE), learning VCDs for mathematics, Natural Sciences, Social Sciences, Indonesian Language, and some general skills CVD and general knowledge as stated before, but also VCD of learning educational cartoons which contain a collection of light stories that are entertaining along with their utilization facilities. This academic cartoon learning VCD is used during rest time. Thus, students who come to emergency schools learn about the subject
matter, but they can also enjoy entertainment (learning through entertainment) provided during recess hours.

The volunteer teachers who were respondents, on the other hand, stated that the availability of instructional media along with its utilization facilities in emergency schools is beneficial for them to manage learning activities. It is further argued that the subject presented through learning media is packaged in an attractive, straightforward, and easy to understand manner. Whenever it is needed, or certain parts of the subject matter are still not difficult to understand, the learning media can be played/used repeatedly. Furthermore, students stated that they had never participated in learning activities that use VCDs at their respective home schools because their original schools did not yet have learning VCDs and the facilities that can be used. This is their new experience.

Most of the 32 students (80%) stated that they could understand the subject easily if it is presented using learning media. Only 8 (20%) indicated that they felt somewhat challenging to understand the subject matter shown through the use of teaching media because they are required to participate in learning activities seriously. Particularly with the subject matter for grade VI, it was stated by the respondents that they preferred science and mathematics Bahasa Indonesia because Bahasa Indonesia subject is not as tricky as science and mathematics.

4 Conclusion

The results of the research can develop learning tools such as; (1) special practicum kits, (2) lesson plans, (3) student activity sheets (LKS), and (4) evaluation instruments. These learning tools have been tested on students at SDN Balaroa and SDN Petobo. This is in accordance with the specific objectives of this research related to the goals of producing fun learning-based learning modules and developing teaching and learning strategies with a fun learning approach. In an effort to increase mental resilience and learning motivation of post-disaster students, the research objectives provided, namely, developing learning about early detection and disaster risk integrated into science subjects in primary schools located in disaster areas. Thus this design can be implemented in accordance with the objectives, namely, developing teaching and learning strategy with a fun learning approach to increase mental resilience and student motivation post-disaster in that is line with the realization of the first research objectives, namely, developing learning about early detection and risk of disasters integrated into science subjects in primary schools in disaster areas.

Learning tools are successfully developed and support the quality of the process and quality of science teaching and learning outcomes. Student activity is dominated by activities using learning tools, field practice, relevant discussions, and activities to practice operational independence that increase along with the high percentage of teacher activity in training these skills to students. Functional independence that is dominantly carried out by students is the skill of observing and sharing tasks in groups to complete group tasks. Students said they were happy with these new learning tools and models developed by researchers; therefore, students were interested in taking part in the next science learning as they had been following. The
teacher considers the learning media that the researcher has developed quite helpful and very useful in the science teaching and learning process. However, it still takes quite a long time to improve the achievement of that goal because the central concept “fun learning” can only be achieved through continuous development and improved in the following year.

References


Perceptions and Anxiety Level of Eight Grade Students Engaged in Guided Inquiry Physics Experiment

L D Oraa\(^1\) and V M Mistades\(^2\)
{voltaire.mistades@dlsu.edu.ph}

Bina Bangsa School - Semarang, Indonesia\(^1\)
De La Salle University, Manila\(^2\)

Abstract. Research on inquiry-based laboratory experiments have shown its effectivity in developing student’s science process skills, critical thinking, problem solving ability, and understanding of the nature of science. In the Philippines, however, information regarding the performance of high school learners doing a guided inquiry Physics experiment (GIPE) is limited. Using a mixed-method approach, the study looked into the perceptions and anxiety level of Grade 8 learners while engaged in a guided inquiry Physics experiment. An adapted scientific ability rubric was used to rate the level of laboratory performance of the students. Their performance was correlated with their anxiety level, which was measured using the Physics Laboratory Anxiety Assessment Scale. The over-all anxiety level of the students was rated as intermediate and there is no clear indication that their laboratory performance is correlated with their anxiety level. Data from the students’ reflective journals and interviews were analyzed qualitatively to reveal categories that emerged from the content of the individual reflections. The following factors are relevant to the students’ laboratory performance: working as a team, supportive behavior, science process skills, use of language, time constraint, and readiness to high level of inquiry.

Keywords: Perceptions, Anxiety, Guided Inquiry

1 Introduction

The goal of science education in the Philippines is to develop scientifically literate students and to prepare them to become informed and active citizens – capable of making judgements and decisions with regards to applications of scientific knowledge that may impact the society. To attain this end, the Department of Education has designed the K to 12 Science curriculum so that concepts and skills are presented with increasing complexity as the learners move from a grade level to the next, which is known as spiral progression. This is with the end in mind that the students will gain gradual mastery of science concepts and develop their science process skills which are essential for them to become critical problem solvers.

However, how can students improve their conceptual understanding and problem-solving skills when the typical classroom setting in the country is still teacher-centered and most of the time, the students are perceived and treated as passive learners [1] waiting like empty vessels to be filled with information by the teacher. In this light, it is important to acknowledge that learning is an active process. It is widely agreed that learning is maximized when students are engaged and involved in their own learning [2]. Experimental sciences such as physics require “hands-on” activities for its concepts to be grasped thoroughly; it is through laboratory
experiments that the laws of physics are verified and confirmed. Alongside with the learning of the physics concepts, the primary goal of the laboratory is to provide an opportunity for the learners to carry out the processes of the scientific method as they conduct investigations and inquiry in order to improve their basic and integrated scientific process skills.

Although physics discussions are combined with a “hands-on component”, the primary goal of the laboratory is being restricted because of the prevalent type of experiment being supplied to the students: confirmatory or “cookbook”. Here, the step-by-step directions on how to arrive at the answer are specified; thus, sending a wrong signal to the students that there is only one formula of solving a science problem [3]. Also, with this setup, Rovira-Figueroa [4] remarked that students tend to focus more on completing the task in the laboratory experiment, while interpreting and presenting the results become secondary. This happens when students blindly follow the instructions given by the teacher or as specified in the laboratory manual. Consequently, the laboratory becomes a place where tasks set are being carried out instead of focusing on the methods and purposes during laboratory work.

Likewise, Hodson [5] asserts that the traditional “cookbook” format does not elicit critical thinking and higher order thinking skills, though he does not deny the fact that there is an explicit function for confirmatory experimentation, but he stresses the need for students to engage in designing at least a part of the investigation, if not the whole. The use of “science as inquiry” and inquiry-based laboratories have been the focal point of most researches because of its effectivity in developing the scientific process skills, critical thinking competence, problem solving ability and understanding of the nature of science among students [6]. A science laboratory program is moving towards more inquiry-based when greater elements are left for students to carry out.

Science inquiry refers to activities that imitate how scientists think and act [7]. It involves engaging learners in scientific practices such as asking scientific questions, experiencing phenomena by designing and conducting investigations, collecting and analyzing data, constructing explanations based on evidence, and sharing findings with others [8]. Arslan [9] formulated a representation to categorize laboratory activities called the Four-Level Model of Inquiry. The classification of a laboratory activity depends on how much the teacher supplies in the process of investigation. The first level is called the confirmation inquiry which is also known as the “cookbook type” of experimentation. Here, the students follow a prescribed procedure given by the teacher just the way how cookbooks are written; hence, the name given to it. Learners also know the answer to the inquiry before the activity starts. Second is the structured inquiry. In this level, the students are given the problem, as well as the detailed instruction on how to arrive at the answer; however, the students have no idea of the outcome, unlike in the confirmatory type of inquiry.

The third level is guided inquiry. The only component that the teacher will supply in this category is the question; the rest will be carried out by the students. This type of inquiry was utilized in this research paper. Finally, the highest level is known as the open inquiry. This is the most challenging for the students because they will go through the whole process of investigation all by themselves - from the formulation of questions to the conclusion. The teacher’s sole function here is to give the area or field of research to study. This is somewhat giving the students the taste of how scientists work which is the essence of science inquiry.

This current research utilized inquiry-based laboratory; specifically, guided inquiry type of experimentation because of its potential to close the science process skills gap among learners. Although there were substantial number of published studies regarding inquiry-based laboratory, information regarding the performance of high school learners in doing higher level of inquiry Physics experiment is limited. For the purpose of extending the study in this area, this
paper provided a snapshot of the laboratory performance, anxiety level, and perceptions of Grade 8 students in conducting a Guided Inquiry Physics Experiment (GIPE).

The purpose of this study was to determine the laboratory performance, anxiety level, and perceptions toward Guided Inquiry Physics Experiment (GIPE) of Grade 8 students from a National Trade School. In particular, it sought to answer the following questions. What is the laboratory performance level of the learners in a guided inquiry physics experiment as presented by the quality of their laboratory reports. What is the anxiety level of grade-8 students on a guided inquiry Physics experiment. To what extent, if any, is there a relationship between the Grade 8 students’ laboratory performance and anxiety level. What are the student’s perceptions about a guided inquiry Physics experiment.

2 Method

2.1 Research Design

A mixed method research was employed for this study to gain a better understanding of the research field. Descriptive statistics was applied to report the laboratory performance and anxiety level of the research participants. Qualitative data was obtained from the students’ reflective journal and interview to determine the respondents’ perceptions about guided inquiry Physics experiment.

2.2 Research Participants

The respondents of this study consist of three (3) heterogeneous intact classes of Grade 8 students from a National Trade School. Each class is composed of roughly eighty-two (82) students. In the laboratory, the students were divided into groups of five to six students per group.

2.3 Research Instruments

2.3.1. Laboratory Performance Rubric

A scientific ability rubric developed by Etkina et al [10] was adapted with permission from the Rutgers Physics and Astronomy Education Research Group. This was used to rate the level of laboratory performance of the participants in delivering a GIPE by way of their laboratory reports. Principally, this was developed to assess the scientific abilities of the learners such as: (a) representing physical processes in multiple ways; (b) devising and testing a qualitative explanation or quantitative relationship; (c) modifying a qualitative explanation or quantitative relationship; (d) designing an experimental investigation; (e) collecting and analyzing data; (f) evaluating experimental predictions and outcomes, conceptual claims, problem solutions, and models, and (g) communicating the results of the experiment. For the present study, the researcher selected only the sets of rubrics in accordance to Rovira-Figueroa’s [4] definition of an effective laboratory report.

2.3.2. Physics Laboratory Anxiety Assessment Scale

The anxiety that was brought about by the high-level physics experiment was explored using the adopted Physics Laboratory Anxiety Assessment Scale [11]. This instrument is
composed of 16 items divided into four sub-dimensions, namely: (a) anxiety about finishing the experiment, (b) anxiety about doing the experiment as intended, (c) constant anxiety towards the physics laboratory, and (d) anxiety related to the use of materials in the laboratory. Three (3) items contained positive judgment while thirteen (13) items involved negative judgments.

2.3.3. Reflective Journal Writing

The research participants individually described his/her experience of the laboratory activity through reflective journal writing. After every laboratory activity, the students were asked to recount their thoughts, questions, and feelings about the activity. There are no guide questions, the learners are free to express themselves, which is vital for keeping a meaningful journal. Towndrow, Ling and Venthon [12] enumerated the benefits of Reflective Journal Writing: it may serve as an instructional and self-assessment tools, reflect the students’ beliefs and attitudes toward science and about learning science, and it gives an opportunity for them to express their happiness, doubts and frustrations which make journals a rich source of information.

3 Result and Discussion

3.1 Laboratory Performance Level of the Learners

The learners were assigned to plan and conduct an investigation to determine the relationship between the mass of a material and the amount of heat that it can transfer. After performing the experiment, each group submitted their laboratory report containing the problem statement, hypothesis, experiment to test the hypothesis, data analysis, interpretation, and conclusion. Using the Laboratory Performance Rubric, the laboratory reports were assessed. Out of 45 groups, only 62% successfully submitted their output on time. Thirteen percent of the submitted manuscripts were found to be irrelevant to the topic. Some of these topics include: “Factors affecting the cooling rate of water”, “Saturation of a solution”, “How to separate salt from water”, and “Soda explosion”.

Characterizing the laboratory performance of the learners in the guided inquiry Physics experiment, almost 50% of the groups obtained a score of 3 (or were able to identify and state the problem to be solved clearly). However, more than 80% of the groups failed to design an experiment that tested the hypothesis. This high percentage affirms Harlen’s [13] claim that designing an experiment is one of the most important and the most challenging part of the guided inquiry experiment. Despite the difficulty, there were eight (8) groups who were able to design an experiment that led to a conclusive judgement. It is interesting to note that they were able to come up with six (6) different set-ups that answers a single question.

Miller [14] advocates the view that when students were given an opportunity to explore a problem and formulate an answer to the problem on their own, creativity shines through. The results of this study support Miller’s statement. In the data analysis part, there were around 15% who were able to present their data clearly but sadly, they could not make sense of the numbers they have obtained. It seems ironic because some of the students who were able to design a reliable experiment, certainly identified the data they needed in order to answer the question.

Evidently, the comments of the students give an impression that they lack integrated science process skills, such as interpreting data and drawing conclusions from it. Nevertheless, teachers must not expect great improvements in the learners’ science process skills especially when they had limited exposure to higher level of inquiry and have been repeatedly performing
confirmatory experiments. Abdulhanung, Supasorn and Samphao [15] remarked that inquiry is one of the most effective teaching approaches to enhance one’s science process skills. Learners that were given, even a few, chances to improve their science process skills through inquiry become more self-confident, scientifically skillful, critical thinkers who are unafraid of doing science [16].

3.2 Students’ Anxiety Level

The data from the Physics Laboratory Anxiety Assessment Scale (PLAAS) showed that the learners disagree with almost all of the items in the first strand regarding anxiety about finishing the experiment. Most of the learners reported that they felt no stress in answering questions related to the conclusion part of the experiment. In fact, they neither fear not being able to draw a conclusion from their gathered data nor being able to reach the correct conclusion. In the same way, majority of the students were not afraid whether their obtained data differ from their hypothesis statement. Furthermore, it is sad to note, that being late with the experiment do not cause any stress to them. The only anxiety they have expressed is in making a visual presentation for their data.

In the second strand – anxiety about doing the experiment as intended – the learners disagree with all four statements. Sadly, majority of the participants were not worried about not being able to understand the purpose of the experiment and whether they do the experiment properly or not. Not being able to determine the right materials for the experiment does not worry them as well. However, contrary to the learners’ negative response on the statement, “I am worried about determining the material required for the experiment”, they have expressed anxiety to the use of the materials in the laboratory. Most of them conveyed that they were uneasy when using laboratory equipment and installing experimental set-up. Commenting on graphs and charts was also difficult for them.

The last strand consisted of statements about constant anxiety towards the physics laboratory. The learners neither feel uneasy doing the physics experiments nor did they feel frightened when asked by the teacher. However, it is very sad to note that half of the respondents conveyed that they would not take Physics lessons if they have a choice. It is sad to know that the respondents do not seem to see the importance of conducting a scientific investigation and writing a laboratory report as seen in their responses in the PLAAS. During the interview, the students expressed enjoyment in doing experiments. However, they only like the part where they manipulate things and see the outcome. All other things that come along with it does not interest them, especially the idea of putting their minds to work and doing tasks beyond their comfort zones.

3.3 Association of Laboratory Performance and Anxiety Level

We know that Physics is often perceived as hard and difficult to understand; a glance at an equation is enough to scare students away. Berber [11] comments that physics laboratory receives an equal portion of negative attitudes as much as physics lessons and exams get, and this negative attitude is expressed as anxiety. In this study, the anxiety level of the Grade 8 students is reported at 3.07, which is intermediate. The correlation coefficient between Laboratory Performance and Anxiety Level was found to be -0.052, which is not significant.

3.4 Analysis of Reflective Journals and Interview

This section presents the result of the interview with the five students who obtained the highest scores and the five students who obtained the lowest scores in the PLAAS. Aside from the interview, the journals of these students were also probed. The data was then transcribed,
coded and categorized into themes. During the interview, the students were asked the following questions:

1. What part of the experiment did you enjoyed most?
2. What part of the experiment did you find difficult to do?
3. Were you able to finish your experiment? If no, what do you think is the primary reason of non-accomplishment?
4. How do you like Physics to be taught?

Analysis of the qualitative data led to identification of themes: (a) factors influencing student performance on GIPE, (b) students’ learning preferences and personality traits, (c) emotional reaction to outcome, and (d) students’ perspective of guided inquiry Physics experiments.

The following factors are relevant to the students’ laboratory performance: working as a team, supportive behavior, science process skills, use of language, time constraint, and readiness to high level of inquiry.

In a collaborative work, communication is vital. If learners contain their thoughts, feelings and circumstances to themselves, barriers to communication are set up [17]. One participant affirmed this by saying that they were able to come up with a good experimental procedure because they have listened to each other’s idea. Another student mentioned that every member of their group felt responsible and commitment to accomplish the task.

Another factor that may influence the students’ performance on guided inquiry Physics experiment is behavior. While the students conveyed that doing this type of inquiry activity is hard and they expressed that it is the most challenging experiment that they did so far, it is pleasing to note that despite all these, the students took the challenge positively. One student articulated, “...I enjoyed because we tried our best to get a good score. I think this activity is the hardest among all the lab activities that we have performed.”

During the interview, one factor that contributed to the laboratory performance’ low result was brought to light. It showed that the students lack the requisite integrated science process skills. The following excerpts from the interview support this:

“...I did not understand the problem”
“...I have measured the water temperature in the three beakers but I do not know how to explain the data I obtained, I don’t know the implication of the values that I got”
“...I don’t know what to write in the laboratory report”
“When I listen to my teacher on how it (hypothesis) is constructed, it seems easy but when time comes to do it by myself, it’s hard. I find it difficult because I don’t understand the problem, I can’t point which variables should be involved.”
“...I really don’t understand the problem, it is confusing”
“I felt nervous because we may not do it right”

The lack of integrated science process skills among students were very much evident in their output. Through the interview, the teacher-researcher learned that the students were taught how to conduct a simple investigation during the first quarter of their Grade 7 science subject. Their task was to perform a simple guided inquiry experiment in Chemistry and to produce a laboratory report. However, after the submission of the manuscript, feedback from their teacher was lacking so they cannot figure out whether what they did was wrong or right. The students were also saying that this is the first time that they were given a high level of inquiry.

Language use was a consistent aspect that was raised by the students. Science is taught using the English language in the Philippines but many of the students do not speak English at home. During the interview, two of the learners expressed difficulty in articulating using the English language. “It’s difficult to express my idea in English, if we’re allowed to write in Filipino,
maybe it will be a lot easier.” Maerten-Rivera et al [18] noted in their study that English Language Arts (ELA) is a significant predictor for science achievement. The aspect of time constraint was also mentioned by the students. A participant expressed that it is hard to plan an experiment when the time is short.

The last factor that has been identified as contributor to laboratory performance is readiness. Readiness is a term used to describe preparation for a transition. “Making our own experiment is very hard, because we were used to follow as instructed in the laboratory worksheet…” This statement from a student clearly suggest that they are not so ready for a guided inquiry Physics experiment. They were accustomed to “cookbook type” type of experimentation, therefore, they needed more guidance and instruction until they reach a certain level of cognitive development required for this high level of inquiry. The teachers must provide intervention programs aimed to develop science process skills, raise learners’ confidence and lower frustration levels while still maintaining a high level of intellectual.

4 Conclusion

Open-ended laboratory and authentic research seem to be a more appropriate way to facilitate students’ development of higher-order inquiry skills [19]. In this light, a guided inquiry Physics laboratory experiment was employed to three (3) heterogeneous intact classes of a National Trade School. The purpose of this study was to provide a snapshot of the responses of Grade 8 students undergoing GIPE. The results revealed that the Grade-8 respondents were not fully equipped for a GIPE. They have obtained below average success rates for the various parts of the laboratory report: problem, hypothesis, experiment to test the hypothesis, data analysis, interpretation, and conclusion. The following factors are relevant to the students’ laboratory performance: working as a team, supportive behavior, science process skills, use of language, time constraint, and readiness to high level of inquiry.

The overall anxiety level of the students in the Physics Laboratory Anxiety Assessment Scale is 3.07, which is rated as intermediate. There is no clear indication that the Physics laboratory performance and anxiety levels of the learners were interrelated.

Interview data revealed that learners wanted their physics course to be rich in experiments. They possess childlike traits who like to manipulate, explore, question, and discover things with adequate level of autonomy. However, they still prefer cookbook type of experimentation over guided inquiry Physics experiment though the former does not develop integrated science process skills among them. The learners perceive the GIPE as intellectually challenging, difficult, and frustrating but it provides experiential learning. Most of the learners do not like to engage on difficult tasks and write laboratory reports. Following instructions in the experiment sheet and answering simple questions eases them. Nevertheless, expressions of sense of achievement were documented when learners successfully finish the task while statements of disappointment were articulated when they failed.

This research study provided the stakeholders a snapshot of the scenario when high school students are given a high-level inquiry laboratory physics task. The data revealed that students experienced difficulty in proposing a sensible answer to the task. Consequently, stakeholders play an important role to develop a scheme leading to the adequate development of basic and integrative science process skills, independence and confidence necessary to complete a task of moderate difficulty among learners. Gradual deviation from participation in procedural lab
activities and adjusting the levels of engagement of students are effective methods to raise students who depend on cook-book type of investigation to complete a slightly new task [19]. Several factors must be considered in designing laboratory programs in the schools so that when level of inquiry is increased, anxiety of learners will not follow. The key is conditioning. The learners must be conditioned to perform laboratory activities in progressing level of inquiry by constantly engaging them in a recurring sequence of learning instruction.

References
[4] Rovira-Figueroa N D L A 2009 Assessing the factors that affect the way(s) high school chemistry students write effective laboratory reports (Doctoral Dissertation, Purdue University).
Module and Learning Resources of Students for Developing a Local Wisdom-Based Biotechnology Module: a Preliminary Research

Desti¹, Fitmawati², Putri Ade Rahma Yulis³, Mayta Novaliza Isda⁴
{email: destibio@edu.uir.ac.id}

Department of Biology Education, Faculty of Education, Universitas Islam Riau. Jl. Kaharuddin Nasution No. 113 Marpoyan 28284, Pekanbaru, Indonesia¹, Department of Biology Faculty of Mathematics and Natural Sciences, Universitas Riau. Kampus Bina Widya Km 12,5 Simpang Baru Pekanbaru 28293, Indonesia², ³. Department of Chemistry Education, Faculty of Education, Universitas Islam Riau. Jl. Kaharuddin Nasution No. 113 Marpoyan 28284, Pekanbaru, Indonesia⁴.

Abstract. There are some of the problems faced in Biotechnology Subject. This research was aims to describe the preliminary research about the development of a local wisdom-based Biotechnology module. It has been carried out with a 4-D model, which is a preliminary research. It show that students assume that the material about nibung is needed in the Biotechnology Subject. They assume that material in Biotechnology was in difficult category (87%). Furthermore, the students rarely learning Biotechnology other than when they are in the class (74%). Overall, students only use learning resources from internet and generally only rely on teaching materials from lecturers (100%). Students assume that it is needed to develop the teaching materials that can help students in independent study, as well as teaching materials that discuss about local commodities. In conclusion, there is a need to develop teaching materials containing research results based on local wisdom for Biotechnology Subject.

Keywords: learning resources, biotechnology

1 Introduction

Nibung (Onchosperma tigillarium Jack Ridl.) is the mascot of Riau Province. That plant is identic with the symbol of Riau’s Malay People. They tend to use nibung for some uses, namely: for materials of buildings, wood bridges, for traditional medicine, for fishery and used the other constructions. The inhabitants of Riau have also utilized Nibung for carpentry supplies, bridge poles, and weaponry such as swords and spears. [1]. The research about some characteristics of that plant was been conducted by characterization of morphological [2], anatomical [3], molecular of nibung [4] and the characterization of ethnobotany of nibung [5] and about local wisdom of nibung [6]. Some specific characters for describing morphology, anatomy, and molecular characters of nibung. All of those characters are needed for Biotechnology Subject to describe about the uses of nibung and can implemented in the application of nibung to increase the economic value of that plant. So, some of characters giving the informations completely.

The study discovered that the Malay people of Riau's Bengkalis Regency are particularly concerned about, respect, and support attempts to conserve nibung plants. They use the words nibung to mean wise, valuable, and wise. Riau people's local expertise in the usage of nibung
may be seen in a variety of ways, including cultural, social economics, and eco-tourism, where there is harmony in the interaction of nature, humans, and constructed environments. It is incorporated into the local community's cultural values, rituals, and religious beliefs. It may be stated that the use of the nibung plant in Bengkalis, Riau is supported by the local population and is carried out responsibly [5].

Nibung was known as one of the members of the mangrove ecosystem by the Riau’s Malay people. It can be found around their villages easily. Nibung is not used in learning in learning process in the schools or universities today yet. Our initial observation shows that the people are known about the nibung plant, but, they did not know that nibung is used as their mascot. Ironically, several Riau locals, particularly students at Universitas Islam Riau's Biology Program, are unaware of these plants. On the other hand, module is one of the media that consisting of some materials and obtaining some of the informations. It can used in Biotechnology Subject. In this case, module is one of the learning materials that important to support the students in learning process for Biotechnology.

As a result, one of the most essential elements needed to assist Biology Students' skill and understanding of their native flora is the construction of a local wisdom-based Biotechnology curriculum. In the learning process in the current Biotechnology Subject was faced by some obstacles consisting of: It was still minimal media and references as learning resources of learning process that can be used in the Biotechnology Subject. This fact is related to the problems of efforts to increase students' understanding of nibung conservation as the flora mascot of Riau Province As a result, it is important to create instructional materials that may offer students with information on contextual learning based on challenges they experience in their everyday lives. In this case, the research about development of Biotechnology module has not been conducted yet, including about local wisdom of Biotechnology module. So, it is necessary to develop a local wisdom-based Biotechnology module to increase the student knowledge about their local commodity. This research aims to obtain information about how the results of the student’s perceptions and the student learning resources of Biotechnology Subject. Those are some stages in a preliminary research of the development of the local wisdom-based Biotechnology module for Biology Student in Universitas Islam Riau. It will be used as a basis for future research to develop of module based on the research about the local commodity in Riau Province.

2 Method

Data was collected in the Biotechnology Subject at Universitas Islam Riau's Biology Program at Pekanbaru, Riau, Indonesia, from April to July 2020. This study used a survey approach that includes observation, interviews with Biotechnology professors, and the distribution of questionnaires to the students. The research and development process begins with the stage that will be discussed in this section. The challenges are determined at this stage by examining the student's learning materials, conducting interviews with ten students out of 92 total students, and observing student references in the Biotechnology field. Live observations of students in the Biotechnology learning process in class 6A were used to gather data on student views and learning references [7].

Overall, this study conduct to get the role information about the perception of students, and their learning references in the Biotechnology Subject. The define process analysis is a stage in the process of describing the first step before conducting research and development research.
This data is required to support the next steps. The student analysis was carried out by looking at the students' Biotechnology Subject learning experience. Percentage approaches were used to do descriptive data analysis.

Furthermore, the collection of data from the questionnaires were measured using a scoring with four answer choices for each statement, namely: 9 statements for the student’s perception, and 7 questions for learning resources of the students in Biotechnology Subject. The instrument uses a Likert Scale measurement in the form of a checklist with four answer choices consisting of strongly agree, agree, disagree, and strongly disagree. Each solution has a scoring interval for each variable. The information obtained from the need analysis questionnaires was analyzed using a score system that included four answer options for each statement. It is used to define a student's impression of the Biotechnology subject, as well as their learning materials and references used in the learning process.

3 Results and Discussions

The findings reveal a lack of learning materials for Biotechnology Subjects that are based on research and local wisdom in the Biology Program, Education Faculty of Universitas Islam Riau, including teaching materials for students that are still not based on students' experiences, as well as the lack of contextual Biotechnology learning resources with their problems. In this scenario, instructors will need to provide learning resources that will help students reach the learning objectives that they must meet in the Biotechnology Subject. It implies that the lecturer plays a critical role in the learning process. This is consistent with the belief that instructors have a critical influence in the educational process and results [8]. It is because lecturers are required to be able to apply and integrate learning materials with the issues that students experience when it comes to Biotechnology materials. Furthermore, learning resources are all of the things that can be implemented to facilitate the learning activity for the purpose of achieving learning goals and can improve student performance in the learning process, perception, interest, and, most importantly, student attitude toward Science [9-10].

There were several challenges in the Biotechnology subject, including the lack of lecture modules created by lecturers based on their research and local expertise. Biotechnology is thought to be one of the most difficult disciplines, and students detest it. The lack of references has an influence on the learning process in this case. This is a difficulty that students in Indonesia confront [11-12].

In this case, the findings of the preliminary study are used to create research-based teaching materials. This supports the viewpoint that the outcomes of the problem analysis at the define stage are the first step in doing research and developing educational materials [7]. Researchers use the study of difficulties in that topic as a starting point for developing instructional materials and overcoming problems in the learning process.

The perceptions of the student were affected by their assumption about Biotechnology Subject. The result shows that student assume that Biotechnology consisting of easy contents to understand, especially for DNA analysis (about 87%). It linked to the perception of student that Biotechnology Subject grouped into a not good category for them. In this case, 60% of students did not like Biotechnology Subject, especially for DNA analysis material which was not interesting for them. Furthermore, some students learns about that material when they attend the Biotechnology class only (74%), and only doing some learning activities for finishing their assignments or their examinations (Table 1).
Table 1. Percentages of student’s perception for Biotechnology Subject

<table>
<thead>
<tr>
<th>No.</th>
<th>Statement Description</th>
<th>Average (%)</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Perception about the presented material that given by Biotechnology Lecturers is easy to understand</td>
<td>78</td>
<td>Agree</td>
</tr>
<tr>
<td>2</td>
<td>Perception about the student’s like for Biotechnology Subject</td>
<td>86</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>3</td>
<td>I found that Biotechnology is useful in learning for my field of study</td>
<td>98</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>4</td>
<td>I found that Biotechnology is useful in my daily life</td>
<td>70</td>
<td>Agree</td>
</tr>
<tr>
<td>5</td>
<td>Perception of DNA analysis material is easy for the students</td>
<td>87</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>6</td>
<td>Perception about the student’s like for DNA analysis material in Biotechnology Subject</td>
<td>60</td>
<td>Disagree</td>
</tr>
<tr>
<td>7</td>
<td>Perception about how often the students study about Biotechnology other than in the class</td>
<td>74</td>
<td>Agree</td>
</tr>
</tbody>
</table>

In terms of learning resources, students tends to get it from the lecturer or the internet. Overall, students only got the information about their learning material about Biotechnology Subject from the Biotechnology Lecturers and the internet (100%). Students assume that it is needed to develop the teaching materials that are attractive, easy to understand, can help the students in independent study, as well as teaching materials that discuss commodities that are easily found in everyday life that make it easier for students to understand the material. According to the student, it is important to develop the module about Biotechnology, especially from research about local plants and based on the local wisdom of people in using the nibung in Riau. It will be can help the student in the learning process, and encourage their enthusiasm in learning about their mascot flora. As a result, the module provides an alternate teaching resource that may offer students with information on contextual learning based on difficulties they face in their everyday lives. This is connected to initiatives to improve pupils' knowledge of nibung conservation as Riau Province's future flora mascot.

Students are asked for their opinion about the existence of the Biotechnology course. They are fully aware that this course is useful for them in their daily life and in society. This is illustrated by the number of students who agreed with the statements in the questionnaire. Students have a positive opinion on the usefulness of Biotechnology courses in their field of study. This subject provides added value for students in their daily lives. This is reflected in the number of students who strongly agree that the Biotechnology course is beneficial for them. In implementing Biotechnology Subject lectures, students think that there is a need for adequate support and facilitation. The findings of the student need analysis questionnaire revealed that the students highly supported the construction of the Biotechnology module based on local wisdom, and that the students chose the kind of writing, how the module is built, and the learning materials to be utilized in their studies.

It is critical to do research and development in order to create a local wisdom-based Biotechnology module that can be used as a teaching tool for biology students. It was necessary to create a biotechnology curriculum that met the demands of the students. All phases of the defining analysis of Biotechnology learning content must be completed in order to create and build that learning material in this situation.

According to [11, 13-14], student needs analysis is important to be a point of view in teaching because it is through needs analysis that the lecturer, students, teaching materials, and teaching procedures can all be connected harmoniously to improve the learning process of
students and to build the character and soft skills of students, as well as to support students in learning. This is in accordance with [9], which argues that effective and relevant learning materials are one of the most significant aspects in fostering a positive attitude toward science among Indonesian students. This subject is also suggested as a way to increase a student's knowledge.

Furthermore, it is suggested that this module can increase the student's understanding and provide solutions to their issues in that topic. According to [15], teachers in New South Wales (NSW), Australia, cited a variety of difficulties to teaching biotechnology, including the complexity of the subject matter and a lack of practical work that was appropriate for the topic of the teaching unit. A module is also a full measurement instrument and the synthesis of a software that can measure objectives [16].

This research has provided important results as a basis to develop teaching material for the Biology Students, especially for Biotechnology Subject at the university level as described by the students. Overall, students have many commented that they would like to see other learning materials for it, for example, a local wisdom based-biotechnology module. It can be an innovation for the students to help them for getting their learning gain in Biotechnology Subject. In this case, a local wisdom-based Biotechnology module seemed like a “tool” to improve their knowledge and can facilitate the integration of life-based learning in Biotechnology Subject. It can be implemented in learning in the university level to make an integration between the learning materials between the student’s daily experiences. It is in line with [17] revealed that the module is of the innovation for the integration of life-based learning in the development of innovative biotechnology learning that was valid, effective, and useful at the schools, university and the local community in East Java.

4 Conclusions

In conclusion, the study of student views and learning resources in the Biotechnology Subject at Universitas Islam Riau reveals that students have positive reactions and expectations for the construction of a local wisdom-based Biotechnology module. They believe that a module for Biotechnology Subjects based on local wisdom is required to assist biology students in their learning process. It is feasible to build a local wisdom-based biotechnology module including study outcomes for Biology Students at Universitas Islam Riau based on preliminary investigation data.

Acknowledgments. Thanks to the Directorate of Research and Public Service, Directorate-General of Research and Development for the Strengthening of the Ministry of Research, Technology and Higher Education, for funding this research through the Research and Public Service Institutes of Universitas Islam Riau (LPPM UIR) Pekanbaru.

References


EAI Computing and Communication in Emerging Regions - CCER

The EAI Computing and Communication in Emerging Regions Series have already published proceedings from more than 20 conferences of various scopes. In line with EAI’s values of equality and openness, their mission is to give greater visibility to research and innovation from emerging regions and share the knowledge worldwide. The audience for the proceedings consists of researchers, industry professionals, graduate students as well as practitioners in various fields. CCER harnesses the Open Access platform to simultaneously guarantee free exposure and distribution, under the Creative Commons license. In addition to being available in European Union Digital Library, the proceedings are disseminated to an even wider audience by being indexed in ProQuest, CNKI, Google Scholar and EBSCO.

European Alliance for Innovation

EAI is a non-profit organization with free membership and the largest open professional society for advancing research careers through community collaboration and fair recognition. Members benefit from finding feedback and mentorship for their work and they are guaranteed to be evaluated fairly, transparently, and objectively through community.

ISSN: 2593-7650

http://eudl.eu/series/CCER | www.eai.eu