Development of Statistical Inference RStudio Practicum Module to Improve Student's Problem Solving Skills

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Abstract. Semester Lesson Plan (SLP) for the Statistical Inference Course based on Outcome-Based Education (OBE) is designed to attain the desired Graduate Attributes (GAs) of the Mathematics Education program. The course will be supplemented with an RStudio Practical Module to guide students in practicum problem-solving based on the teaching module. The synergy between the lesson plan and the practical module aims to enhance students' problem-solving skills related to research topics in Mathematics Education. The applied research of this product aims to: 1) Determine the level of students' problem-solving abilities after using the RStudio Practicum Module based on the SLP for Statistical Inference with an OBE approach, and 2) Evaluate whether the quality of the RStudio Practicum Module based on the SLP for Statistical Inference with an OBE approach fulfills the criteria of validity, practicality, and effectiveness. The research and development process adheres to the ADDIE model, encompassing the stages of analysis, design, development, implementation, and evaluation. The research subjects are students enrolled in the Statistical Inference course from two classes in the Mathematics Education program. Based on the validity test, a score of 89.28 was obtained, and the average class-level learning mastery was 84.08

Keywords: RStudio Practicum Module, Statistical Inference, ADDIE.

1 Introduction

Teaching materials in the form of Practicum modules are systematically designed learning programs that are clearly measurable and aimed at achieving specific learning objectives [1]. The development of this practicum module was initiated due to student complaints about learning statistics manually. However, learning statistics is related to data analysis for research in drawing conclusions from inferential statistical results. Components of this practicum module material include learning outcomes, learning materials, tutorials using SPSS, and exercises for independent problem-solving. The module serves as a self-learning tool, allowing students to learn at their own pace. The primary goal of module-based learning materials is for readers to be able to absorb the material independently [2] .

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One of the scopes of the national higher education standards according to Permendikbud Number 30 of 2020 [3] is the standard of learning processes. The learning process standard is a minimum criterion for implementing learning programs in a study program to achieve graduate outcomes. The learning process standards include: 1). Characteristics of the learning process, 2). Planning of the learning process, 3). Implementation of the learning process, and 4). Student workload. The second learning process standard, namely learning process planning, is prepared for each course and presented in the Semester Lesson Plan (RPS). With the existence of the RPS, standard learning outcomes, learning materials, learning processes, and evaluation can be controlled maximally. With the RPS, variations in the four components caused by differences between instructors can be minimized [4]. The development of RPS and practicum modules based on OBE in student problem-solving skills in the course. In line with the 5 priority programs of LPPM 2024, namely supporting research and community service, 1) Implementation of the OBE Curriculum, 2) Improving the Quality and Quantity of International Scientific Publications, intellectual property, and innovation, 3) Improving the Quality of competencies and reputation of competitive and adaptive human resources to the development of science and technology, 4) Strengthening regional and international cooperation, 5) Implementation of GUG based on the development of science and technology. Statistical Inference is a branch of mathematics that plays an important role in mastering mathematics. In addition, Statistical Inference is a field of expertise that is often used in everyday life, for example to analyze student scores, determine the effectiveness of a company's products, and play a role in quick counts during elections. In this course, various statistical tests and their applications in everyday life will be studied.

In mathematics, mathematical problem-solving ability is defined as an effort to solution to a mathematical problem by involving the skills and knowledge possessed and must be honed by doing mathematical problem solving skills and knowledge possessed and must be honed by carrying out the activities contained in the problem solving process [5]. At the beginning of each Statistical Inference lecture, a Semester Learning Plan (RPS) is presented, which is a document that is a contract between students and the lecturer that must be delivered at the beginning of the lecture meeting as a reference in conducting learning. Outcome-Based Education (OBE) is an educational system that focuses on graduate outcomes. Curricula designed based on OBE must refer to clear learning outcomes. The RPS developed based on OBE is assisted by the availability of the RStudio Practicum Module. RStudio is open-source, so it can be downloaded and installed without a license. R itself is a programming language and statistical computing environment that is popular in the world of research and data analysis. With the practicum module, students are able to independently learn and test each problem related to research on themes in Mathematics Education. Thus, students' problem-solving abilities are more measurable. With continuous repetition on different materials related to research needs, students will become more accustomed to using R and it is hoped that their data analysis skills will improve so that they can solve existing problems. In accordance with the graduate profile of the Mathematics Education Study Program, namely 1) As a Mathematics Educator, 2) Becoming a researcher in the field of Mathematics Education, 3) Edupreneur in the field of Mathematics Education, 4) Facilitator of Mathematics Education programs, mathematics education consultant, 5) Writer.

2 Method

The subjects of this research are students enrolled in Class A of the Statistical Inference course in the Mathematics Education program. The research aims to develop an RStudio Practicum Module for Statistical Inference based on Outcome-Based Education (OBE) to enhance students' problem-solving abilities. To produce Semester Lesson Plan and RStudio Practicum Module for Statistical Inference based on OBE, the researcher employed a Research and Development (R&D) approach, specifically the ADDIE model, which consists of analysis, design, development, implementation, and evaluation. The development procedure of this research is outlined below.

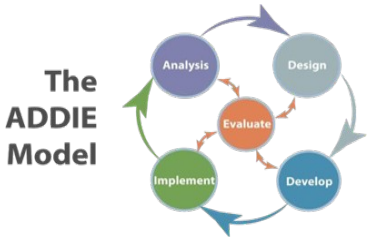

Fig1. ADDIE Development Model Procedure

3 Results

Based on Semester Lesson Plan for Statistical Inference using a team-based project and case method approach, there are specific concepts that students are expected to master throughout the semester. A hallmark of team-based projects and case methods is that problem-solving is undertaken and completed by team members. This characteristic necessitates the inclusion of several new variables, particularly human factors. Therefore, the complexity of team-based projects and case methods arises not only from the scale of the problems but also from the intricate cognitive, psychological, social, and behavioral interactions among group members during the problem-solving process [6]. There are four main characteristics of team-based projects and case methods: cognitive, psychomotor, motivational, and affective (interpersonal and attitudinal). The performance of team-based projects and case methods is determined by the composition of these four types of dispositions among all team members. Mastery of the material available in the RPS, supported by the use of RStudio in discussing cases presented in the module, aims to enhance students' problem-solving abilities and practical skills in inputting, processing, analyzing, and drawing conclusions based on the available cases. The combination of both is expected to produce mathematics educators who are conceptually strong and possess practical skills that can be applied in the workplace as teachers in schools or for the needs of postgraduate studies. Before using RStudio, the researcher explained RStudio and its installation instructions to the students. The goal was for all students to experience using RStudio firsthand in processing and analyzing the available cases. Of the 10 groups, 80% of student groups were able to use RStudio to process and analyze cases.

3.1 Post-test Results of Students' Problem-Solving Skills

The results of the students' problem-solving skills test based on the scoring guidelines were as follows. Determining the number of students who passed (learning mastery) with a score of ≥ 75 or were in grade A (excellent) or B (good). Determining the percentage of mastery per class or Class Mastery Percentage (CMP) using the formula:

$$\text{Class Mastery Percentage (CMP)} = \frac{\text{(Number of Students Who Passed)}}{\text{(Total Number of Students)}} \text{x100\%}$$

A class is considered to have mastered the material if ≥ 85% of students in the class have achieved a score of ≥ 75. For the average post-test score of 52 students, 3 students scored in grade C (sufficient), 19 students scored in grade B (good), and 30 students scored in grade A (excellent), with an average learning outcome of 84.08. The student learning mastery is 84.08%. This means that a total of 49 students or 94.23% passed. This means that a total of 49 students or class mastery percentage (CMP) is 94.23%. This means that it exceeds the limit of ≥ 85% of students who have achieved a score of ≥ 75.

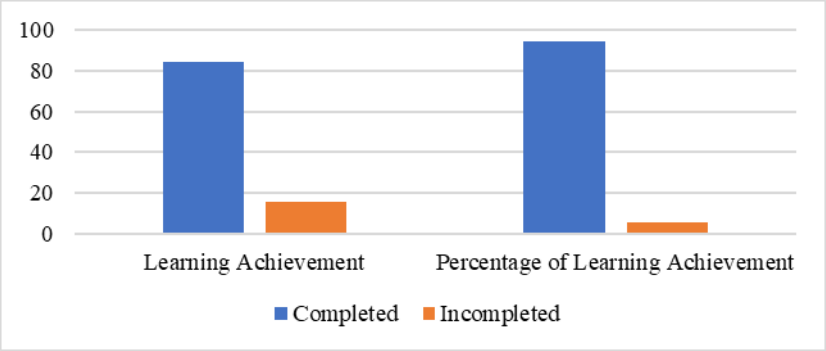

Fig 2. Diagram of Student Learning Achievement Percentage

3.2 Validation Results of the RStudio Practicum Module

The RStudio Practicum Module that has been developed must go through a validation process to ensure the content aligns with the previously developed lesson plan. The validation process includes two aspects: media validation and material validation.

a) Media Validation

The media expert validator is a lecturer at UNIMED. The media expert's validation assesses the feasibility of the media and provides comments and suggestions for improving the module, particularly related to components, content, interface, and technology. The table below presents the validation results from the media expert.

Tabel 1. Table of Media Validation Results for the RStudio Practicum Module for Inferential Statistics

Assesment Aspect	Item No	Validator 1	Validator 2	Validator 3	Total Score per Aspect	Percentage	Category
A. Appearance	A1	4	4	4	141	85,45%	Very Valid
	A2	4	4	4			
	A3	5	5	4			
	A4	4	4	4			
	A5	4	4	5			
	A6	3	5	5			
	A7	4	5	4			
	A8	4	4	4			
	A9	4	4	5			
	A10	3	5	5			
	A11	4	5	5			
B. Technical Aspect	B1	3	4	5	130	86,67%	Very Valid
	B2	4	5	5			
	B3	4	5	5			
	B4	3	5	4			
	B5	4	4	5			
	B6	4	4	4			
	B7	3	5	5			
	B8	4	4	5			
	B9	4	5	4			
	B10	4	5	5			
C. Interface	C1	4	5	4	161	89,44%	Very Valid
	C2	4	5	4			
	C3	4	4	4			
	C4	4	5	5			
	C5	4	5	5			
	C6	4	4	5			
	C7	4	5	5			
	C8	4	5	5			
	C9	4	4	4			
	C10	4	5	5			
	C11	4	5	5			
	C12	4	5	5			
D. Technolog	D1	3	4	5	26	86,7%	Very Valid
	D2	4	5	5			
Total					**458**	**87,06%**	**Very Valid**

From the table above, it can be concluded that the media validation results from three media experts yielded an average score of 87.06%, indicating that the results are valid and fall into the "very valid" category for further testing. In addition to the validation results, the validators also provided suggestions and comments for improving the media. The comments or suggestions for improvement can be seen in the following table:

Table 2. Comments and Suggestions for Media Improvement

No	Validator	Comments and Suggestions
1	Validator Media 1	Clarify the title on the cover
2	Validator Media 2	Improve the cover design and coloring
3	Validator Media 3	Ready for use

b) Material Validation

The material expert validator is a mathematics lecturer at UNIMED. The material expert's validation assesses the feasibility of the material and provides comments and suggestions for improving the content in the module. The table below presents the validation results from the material expert

Table 2. Table of material validation results for the RStudio Practicum module for Inferential Statistics

Assesment Aspect	No Item	Validator			Total Score of Aspect	Percentage	Category
		1	2	3			
A. Concept Component	A1	5	5	5	98	93,3%	Very Valid
	A2	4	5	5			
	A3	5	4	5			
	A4	5	4	5			
	A5	5	4	5			
	A6	4	4	5			
	A7	5	5	4			
B. Language Components	B1	5	5	4	80	88,8%	Very Valid
	B2	5	5	4			
	B3	4	4	5			

	B4	4	4	5			
	B5	5	4	4			
	B6	5	4	4			
	C1	5	4	5			
	C2	4	4	5			
C. Presentation Components	C3	5	4	5	69	92%	Very Valid
	C4	5	4	5			
	C5	5	4	5			
	D1	4	5	4			
	D2	5	5	4			
D. Format Components	D3	5	5	4	69	92%	Very Valid
	D4	5	5	4			
	D5	5	5	4			
	E1	4	5	4			
E. Construction Components	E2	5	5	4	41	91,1%	Very Valid
	E3	5	5	4			
Total					**357**	**91,5 %**	**Very Valid**

Based on the table above, it can be concluded that the validation results of the material by 3 mathematics experts yielded an average score of 91.5%, where the results are categorized as valid and fall into the "very valid" category for further testing.

4 Discussion

Based on the results of the study, it was found that the developed RStudio Statistics Inference module reached the level of learning completeness with a very valid level. However, what is an important note for us is that the achievement of the Graduate Learning Outcomes (CPL) of

the Mathematics Education Study Program imposed on the OBE curriculum-based Inference Statistics course must be supported by other device instruments. The Rstudio module was developed based on the Statistics Inference Semester Learning Plan (RPS) with a case method learning model approach and team-based learning. In the RPS there is a description of the stages of achievement of the RPSs based on the compiled material, course assignments, summative and formative questions, student satisfaction surveys and all publications. All the tools are designed to ensure the achievement of the learning objectives of the Inference Statistics course.

5 Conclusion

Based on the results of the research, the RStudio Practicum Module was developed using the ADDIE research and development method, with the stages of analysis, design, development, implementation, and evaluation. The research subjects were 52 students from the Mathematics Education Program who took the Statistical Inference course. Based on the validity test, a score of 89.28 was obtained, with an average classical learning mastery of 84.08.

References

[1] Amin, A.K.: Analysis of Teaching Materials for Statistics Modules in the Mathematics Education Programme of IKIP PGRI Bojonegoro. Jurnal Pendidikan Edutama. pp. 1-8 (2016)
[2] Harman, H.: Development of Teaching Materials in the Form of Space Analytic Geometry Modules for Students of the Mathematics Education Programme FKIP UNBARI. Jurnal Ilmiah Dikdaya. pp. 136-145 (2022)
[3] Kementerian Pendidikan dan Kebudayaan. National Education Standard, Jakarta (2020)
[4] Kusmanto, J.: Development of Semester Learning Plan (SSP) for English Course Based on Task- Based Language Teaching (TBLT). Jurnal Pendidikan Bahasa dan Sastra. pp. 1-17 (2019)
[5] Setiawan, M.: The Effect of Maths Anxiety on Students' Problem Solving Ability. Qalamuna Education Journal, Social and Religion. pp. 239-256 (2021)
[6] Lightner, S.: Team-based activities to promote engaged learning. College Teaching. pp. 5–18 (2007)