Blended-Based Integrative Learning Design Framework Learning Model: Improving Numerical Ability and Competency in Evaluation of Student Learning Results

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Abstract: The objectives of this study are to: (1) create a blended learning-based integrative learning design framework for learning outcomes evaluation courses; (2) assess the viability of such a framework; and (3) ascertain the usefulness of the integrated learning design framework learning model based on blended learning. (4) determine whether learning outcomes evaluation courses benefit from the blended learning-based integrative learning design framework learning model; (5) being aware of the numerical proficiencies and aptitudes in the course assessment of the learning objectives of the students. techniques used in research and development (R&D). The results of the study show that: the blended learning-based learning model is highly conceivable; the integrated learning design framework is highly practicable; In order to improve learning outcomes in very high learning outcomes evaluation courses, the learning model is an integrated learning design framework based on blended learning. The "medium" category has a score of 0.63 (0.7 > (N-gain) ≥ 0.3), indicating that it is highly effective in enhancing student learning outcomes. Additionally, numerical ability and competency in courses that evaluate student learning outcomes are very high, with a 42.16 rise.

Keywords: learning model; integrative learning design framework; blended learning; numerical ability; evaluation of learning outcomes

1 Introduction

Independent learning remains a barrier to learning process implementation, particularly in courses that assess learning outcomes. In the area of evaluation of learning outcomes in the undergraduate mechanical engineering education curriculum, FT UNIMED's learning outcomes are as follows: At the elementary and secondary education levels, students must be able to: (1) comprehend and demonstrate proficiency in applying principles, procedures, and techniques to assess learning processes and outcomes; (2) grasp and analyze the evaluation procedures of learning processes and student learning outcomes; and (3) assess learning processes and outcomes.

The development of the Integrative Learning Design Framework based learning model based on blended learning aims to improve the numerical abilities and competence of evaluating student learning outcomes. This model combines an integrative learning approach with the use of technology in the learning process.

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The Integrative Learning Design Framework is a learning approach that integrates various aspects of learning, such as content, methods, and evaluation, to achieve more holistic learning goals. In this model, students will be involved in various learning activities that involve problem solving, collaboration, and reflection.

Blended learning is a combination of face-to-face learning and online learning. In this model, students will take part in face-to-face learning in class and partly online through a digital learning platform. This allows students to study independently and flexibly, while still receiving guidance and interaction with teachers and classmates.

Blended learning, as defined by Garrison & Vaughan [1], is a learning approach that blends online and in-person instruction. Optimizing the integration of spoken communication in in-person learning and written communication in online learning is the fundamental tenet of the blended learning learning paradigm. Most of the time, using this model can raise the standard of instruction, which is why top colleges in the globe have adopted it as a trend.

Instructors can execute the blended learning model in four steps, according to Ningsih [2] and Suryani [3]: (1) supplying information and creating instructional materials that incorporate learning strategies. Internet before putting in place in-person instruction; (2) Tell students to talk about e-learning resources in in-person meetings and online course forums; (3) Offer hands-on instruction on the material clarification that is covered in in-person meetings, which can then be discussed in in-person meetings and online courses; (4) Assessment, specifically comments on the in-person learning experience. Both in-person and virtual classroom settings can be used for evaluation. In-person sessions can use quizzes to discuss quizzes.

The Education Outcome Evaluation course is heavily involved in calculating and processing data related to the research instrument as a whole. Therefore, counting ability is included as an indicator of numerical ability. Numerical aptitude is essentially a unique skill to calculate. According to Leoni [4], numerical abilities are aptitudes pertaining to numbers and counting. According to Suparlan [5], numerical ability is the capacity to do arithmetic operations as well as answer mathematical puzzles. According to Astuti et al. [6], numerical ability is the capacity for quickness and precision when applying fundamental arithmetic operations. Thus, it may be concluded that numerical competence is a skill associated with precision and quickness in resolving mathematical issues, such as computation tasks.

1.1 The Nature of Evaluation of Learning Outcomes

According to Arifin and Setiawan [7], evaluation is essentially a systematic and ongoing process that establishes the quality (worth and significance) of an object based on specific standards and considerations so that it can be completed without assessment. This definition is consistent with the one given above for evaluation. Next, go over a few aspects of evaluation, including: 1). Evaluation is a procedure; it is not a product. The outcomes of evaluation processes provide an explanation of an object's quality in terms of its value and significance. Secondly. Evaluating an object is done to ascertain its quality, particularly with regard to its value and significance. (3) The worth and advantages of the item under evaluation can be ascertained by taking these factors into account. Regardless of the factors, these activities are not categorized as evaluation activities. (4) Considerations of value and meaning must be based on certain criteria.

Learning outcome evaluation comprises the following topics: Learning outcome evaluation comprises several key concepts, domains, and evaluation steps. Additionally, test and nontes techniques are used as a tool for learning outcome evaluation. Lastly, there are features, principles, forms, and types of learning outcome tests. Finally, testing the validity and reliability of learning outcome tests is covered in section six. Analyzing the Test Items to Determine Learning Outcomes, establishing learning success profiles, ranking the subjects, and assigning final grades.

1.2 Learning Model Integrative Learning Design Framework

The integrative learning design framework model is a learning design specifically developed for future learning processes, namely online-learning that optimizes the use of communication technology. To determine the approach to be used in this learning by involving the internet as a means to obtain information about the material to be studied in class, it does not have specific rules but is adapted to the conditions encountered in the field, the teacher as a designer, the development of material in online learning becomes responsible responsible for compiling a learning model.

The Integrative Learning Design Framework consists of four main stages, namely: (1) Preparation Stage: At this stage, the teacher plans and prepares the learning material to be delivered. The teacher also determines learning objectives and chooses learning methods that suit the needs of students; (2) Experience Stage: At this stage, students are involved in learning experiences that involve interactions with teachers and classmates. Learning can be done face-to-face in class or through online platforms. Students are given the opportunity to discuss, collaborate, and carry out independent exploration; (3) Reflection Stage: After the learning experience, students are asked to reflect on what they have learned. They were asked to identify new understandings, difficulties encountered, and progress made. This reflection can be done individually or in groups; (4) Refinement Stage: At this stage, students are given the opportunity to improve their understanding through additional activities or assignments given by the teacher. They can also participate in group discussions or get feedback from the teacher to improve their understanding.

This ILDF (Integrative Learning Design Framework) module can be utilized in a range of online learning situations, such as creating electronic performance support systems, online learning communities, online courses for universities, and corporate training, according to Nada Dabbagh [8]. The exploration, realization, and assessment phases are the three steps or development phases that make up the ILDF module as a whole. However, some people additionally include a stage that is called reflection.

1.2 Blended Learning

According to Hew and Cheung [9], blended learning entails having some of the student's aspects in time, place, and control over the internet while also having at least some of the learning done in supervised settings. In blended learning, instructors must maintain control over online instruction to ensure that students' autonomous learning processes are directed toward meeting learning goals.

According to Kaur [10], blended learning has the following benefits: (1) Establishing a learning environment in which students must remain engaged through reading, speaking, listening, and thinking exercises; (2) Combining in-person and virtual learning delivery methods to enhance learning opportunities for all students with different learning styles; (3)

Combining in-person and virtual learning to increase teacher enthusiasm, accountability, and proficiency in accurate assessment; and (4). allows for the structured delivery of content in accordance with the unique learning requirements of each student, enhancing the individualization, relevance, and flexibility of learning; (5) combines the best aspects of both online and in-person learning to give teachers and students the flexibility and accessibility of online learning without compromising in-person social interaction.

Blended learning, broadly speaking, is an educational approach that combines online digital learning with conventional learning methods [11]. Because it is widely accepted that universities use blended learning, blended learning is being developed at universities throughout the world (Ibrahim & Nat, 2019). A learning management system (LMS) that integrates online, in-person, and real-world learning experiences can bundle blended learning applications [15]. Modle, Edmodo, and Schoology are a few forms of LMSs.

1.4 Numerical Ability

Numerical ability is one part of calculating operations in mathematics and is very much needed in solving problems in physics. Numerical ability is the ability, accuracy and accuracy in calculating and usually the tests tested are mathematics and number series [16]. Numerical ability is closely related to a student's level of intelligence and knowledge. The knowledge in question includes ideas, concepts and understanding that humans already possess [17].

There are four ways to measure numerical ability: mathematical computations, logical reasoning, problem-solving, and the capacity to distinguish between numerical patterns and their connections. The capacity to perform basic calculations, such as square roots, logarithms, and common computations, is known as mathematical computation. The capacity to explain logically, cause and effect, and methodically is a prerequisite for logical thinking. The capacity to comprehend a narrative and then translate it into a mathematical formula is known as problem solving. Analyzing the most logical and consistent order of related numbers or letters is a sign of sharpness in numerical patterns and relationships [18].

If pupils grasp the signs included in numerical abilities, they will be able to think critically, logically, analytically, methodically, and creatively. According to Indrawati's assertion [19], numerical ability tests are a useful tool for assessing an individual's intellectual capacity, particularly their capacity for reasoning, calculation, and logical thought. In addition, Cahyono, Masykuri, and Ashadi [20] claimed that numerical ability is a unique arithmetic skill that helps pupils comprehend and resolve issues requiring advanced cognitive skills, such as problem-solving techniques.

The following are the research's three main questions: (1) Is the blended learning-based integrative learning design framework learning model appropriate for use?; (2) Is it feasible to use? and (3) Is it effective in raising learning outcomes?

1 Method

The Borg and Gall model was used to generate this research, which is classified as research and development (R&D) [21]. In the third semester of the Learning Outcomes Evaluation course, the Department of Mechanical Engineering Education at the Faculty of Engineering, Unimed, conducted this study in the academic year 2023/2024. Specifically, professionals in instructional design, graphic design, learning materials, and learning media were the experts involved in the study project, which involved developing an integrative learning design framework based on blended learning. Students and lecturers participate in validation groups, individual trials, small group trials, and field studies as part of development research.

Three categories of data collecting are used in research and development: development, validation testing, and preliminary studies. Depending on the goals of each study stage, certain data collection methods are used. In addition to a literature review, questionnaire approaches, observation, and documentation were selected for the preliminary investigation. These three methods are typically applied concurrently and work best together.

Data analysis techniques on media feasibility are adopted from media feasibility according to Mardapi [22], analysis can be carried out in the following stages:

1) Scores from questionnaire assessments obtained from experts (media and materials) and student responses in the form of quantitative data are converted into categories with the guidelines in the following table:

Tabel 1. Guidelines for the Questionnaire Rating Scale

Category	Score
Very good	4
Good	3
Less	2
Very less	1

2) Calculate the average score of the instruments using the following formula:

$$M = \frac{\sum X}{N}$$

Information:
M = Average score
$\sum X$ = Total Score
N = Number of Appraisers
Changing the average score into a qualitative value with the following assessment criteria criteria into a quantitative value..

Table 2. Assessment Criteria

Score Range	Criteria
$X \geq M$ + SBi	Very Decent
M + SBi > $X \geq M$	Eligible
$M > X \geq M - 1$ SBi	Less Eligible
$X < M - 1$ SBi	Less Feasible

These data allow for the compilation of a module assessment criteria table, which results in the following table:

Table 3. Scoring Assessment Criteria

Score	Range Score	Category
4	X ≥ 3,0	Very Eligible
3	3,0 > X ≥ 2,5	Eligible
2	2,5 > X ≥ 2,0	Inadequate
1	X < 2,0	Not Eligible

A minimal value of "L" in the Eligible category determines the module's feasibility value in this study. Thus, the module development product is appropriate for usage if the aggregate results of evaluations by subject matter experts, media experts, and students indicate a final grade of "L".

The purpose of this expert validation test was to determine the suitability of developing an integrative learning design framework based on blended learning. The lecturers are experts in contextual learning and media. The following formula can be used to determine the validation test results:Information:

$$\text{Percentage} = \frac{\sum score\ per\ item}{\sum maximum\ score}\ x\ 100\%$$

The results of the expert validation are then adjusted according to the criteria in the following table:

Table 4. Validity Level Conversion

Achievement Rate (%)	Category	Description
81 – 100	Very Valid	No need to revise
61 – 80	Valid	No need to revise
41 – 60	Valid Enough	Revised
21 – 40	Invalid Revised	Revised
0 – 20	Invalid Revised	Revised

The practicality test results can be calculated using the following formula:
Information:

$$\text{Presentase} = \frac{\sum score\ per\ item}{\sum maximum\ score}\ x\ 100\%$$

The results of the expert validation are then adjusted according to the criteria in the following table:

Table 5. Practicality Level Conversion

Achievement Rate (%)	Category	Description
81 – 100	Very Practical	No need to revise
61 – 80	Practical	No need to revise
41 – 60	Fairly Practical	Revised
21 – 40	Less Practical	Revised
0 – 20	Invalid	Revised

Effectiveness Test

Learning objectives are measured and concept understanding test questions are supplied in order to assess the product's effectiveness. Subsequently, the pretest and posttest results are analyzed. The N-gain formula, which is based on the average gain, is used to compare the improvement in student learning outcomes attained before and after employing interactive instructional resources. The pre- and post-test average values are compared to determine the gain score (g). Formula: The average gain comparison (N-gain) [23] is shown in this way:

$$g = \frac{S\ post - S\ pre}{S\ maks - S\ pre}$$

Information:

S post : Average Post-test score
S pre : Average Pre-test score
S maks : Maximum score

Next, if this value is obtained, the next step is to convert the value into an interpreted gain value as in the table below:

Table 6. Interpretation of Gain Values

No	Value (g)	Classification
1	(N-gain) ≥ 0,7	High
2	0,7 > (N-gain) ≥ 0,3	Medium
3	(N-gain) < 0,3	Low

3 Results and Discussion

3.1 Results

The quality of the product being developed will carry out several stages of validation and assessment by material experts, design experts, and graphic design experts.

Table 7. Results of Material Expert Assessment of the Five Aspects

Aspect	Material Expert		Total	Average Score
	I	II		
Introduction	3,75	3,75	7,5	3,75
Contents	3,67	3,67	7,34	3,67
Learning	3,31	3,62	6,93	3,47
Summary	3,67	3,33	7	3,50
Assignments/Exercises	3,43	3,43	6,86	3,43
Total			35,63	
Average Overall Score				3,56
Category				Very Eligible

The results of the assessment of the five aspects by 2 material experts can be visually seen in the diagram below:

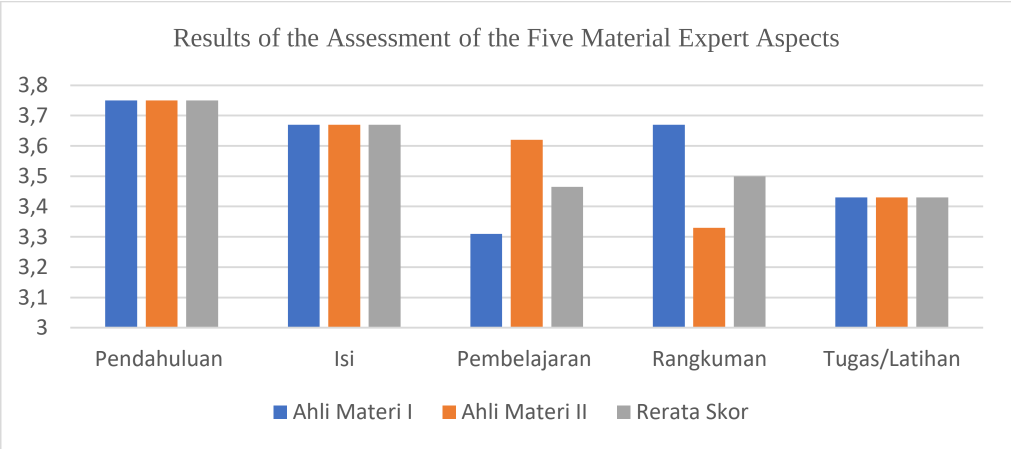

Fig. 1. Bar chart of the results of the Material Expert Assessment

The introduction component gets the greatest average score (3.75) among the various aspects, while the content aspect has the lowest score (3.43), according to the data from the material expert validation results above. The two material experts awarded a "Very Appropriate" rating for the learning aspect based on four indicators: the concept map's depiction of the material to be studied, the relationship between the material being studied and earlier material, the clarity of learning objectives, and the clarity of the instructions for using the teaching materials. In the content aspect, the score was considered low on the clarity indicator providing examples to clarify the material, but the category for the content aspect was still classified as "very adequate".

Table 8. Assessment Results of 2 Blended Learning Media Experts on the Three Aspects

Aspect	Media Expert		Total	Average Score
	I	II		
Display	3,42	3,34	6,76	3,38
Usage	3,35	3,57	6,92	3,46
Utilization	3,42	3,48	6,90	3,45
Total			20,59	
Average Overall Score				3,43
Category				Very Eligible

The results of the assessment of the three aspects by 2 media experts can be seen visually in the diagram below:

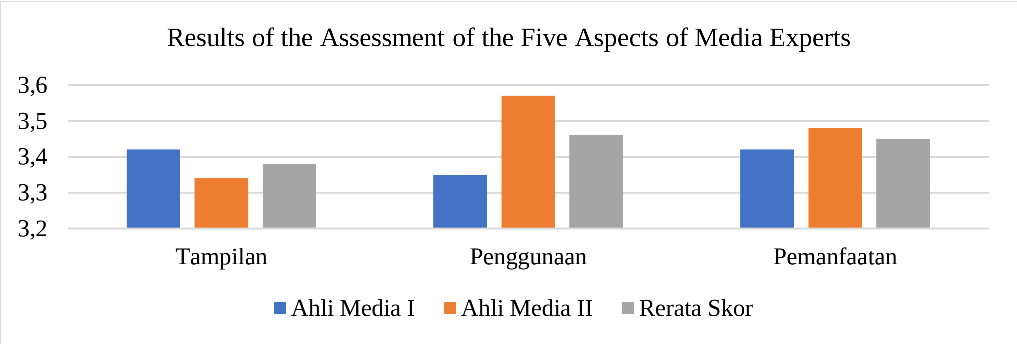

Fig. 2. Bar Diagram of Blended Learning Media Expert Assessment Results

Based on the diagram above, the results of two media experts' assessments of blended learning show that the display aspect consisting of 18 indicators has the highest average score (3.38) compared to the usage and utilization aspect, while the usage aspect consisting of 6 indicators has the lowest average score. that is equal to 3.46. Of the 6 indicators, there are 2 indicators including: ease of use of blended learning; the ease of accessing the product menu was assessed as less feasible by media expert II, while media expert I gave a rating as very feasible and feasible, but after averaging and converting it on a scale of 4 the results were still in the very feasible category ($X \geq 3.0$).

Table 9. Results of Assessment of Three Aspects by Beta Test 2

Aspects	Average Score
Learning	3,23
Display	3,25
Average Overall Score	3,24
Category	Very Eligible

Based on the results of the beta 2 test assessment of three aspects, it is known that the programming aspect received the highest average score (3.41) compared to the other two aspects. In the programming aspect, the item for completeness of module identity (title, compiler, publishing agency, and year of publication) had the highest average score of 3.47, followed by the item for ease of access to exit from the product at 3.41. In the programming aspect, there are 2 items that have a low score compared to other items, namely the item ease of using the product and the accuracy of button functions and navigation with links, namely 3.06. The learning aspect obtained the lowest average score (3.17) compared to the other two aspects. The item on the accuracy of using modules in implementing independent learning received the lowest mean score (2.97) compared to other items. The overall average score for these three aspects is 3.24, which is qualitatively included in the "very appropriate" category ($X > 3.0$).

Based on this table, it can be seen that the average pretest score is 32.65 and the average posttest score is 74.81. This shows an increase. There are 3 students who have not reached a competency of 70. Apart from looking at the average obtained from the pre-test and post-test, they can also look at the score gain, which is as follows:

$$g = \frac{S\ post - S\ pre}{S\ maxs - S\ pre}$$

$$g = \frac{74{,}81 - 32{,}65}{100 - 32{,}65}$$

$$g = \frac{42{,}16}{67{,}35}$$

= 0,63

The gain score in the "medium" category (0.7 > (N-gain) ≥ 0.3) is determined by comparing the average pretest and posttest results after learning with the module. This is based on the computation above. The improvement in the average posttest score indicates that, after students utilize the product for learning, the module is generally successful in raising comprehension of the idea of learning outcome evaluation.

3.2 Discussion

The teaching materials used have minimal explanations because they only contain a summary of the material, a collection of formulas, practice questions, are not interesting and are not interactive. Based on interviews with lecturers, students have difficulty understanding material that is abstract and requires visualization such as three-dimensional material. These difficulties are caused by students' lack of understanding of concepts. Solving problems in three-dimensional space requires visualization, so that students can re-communicate a concept they have learned [24].

The evaluation criteria for module products, which include learner control, accuracy of the material, curriculum compliance, material that is current, clear discussion, ability to motivate students, student participation, and provision of usage instructions, can be met by module products, making them feasible [25].

Additionally, the module product complies with Alessi & Trollip's [26] list of multimedia criteria, which includes the material's breadth, order, and clarity as well as its suitability for the learning objectives, availability of study guides, conclusions, and summaries, as well as navigation and interfaces, and the inclusion of a glossary.

Furthermore, the module assessment criteria are based on Romiszowski [27], namely material validated by material experts, supported by appropriate media, examples and practice questions in accordance with learning objectives, and the level of difficulty of the questions is adjusted to student abilities. Apart from being based on these assessment criteria, the module product also applies the characteristics of the module, namely: Mayer's seven multimedia design principles [(1) self-instruction, (2) self-contained, (3) stand-alone, (4) adaptive, (5) user-friendly, and 28] for delivering content in the form of animation and video. These include the following principles: individual differences, coherence, modality, proximity in time, multimedia, redundancy, and modality fidelity.

Because the offered information incorporates animation and video content that visualizes three-dimensional material in addition to text and images, it is thought to be useful in improving conceptual understanding. Rogness's [29] assertion that the use of visualization can enhance pupils' conceptual understanding lends credence to this. Videos or animations can be used as the visual form [30]. Research by Lasmiyati & Harta [31] indicates that teaching materials in the form of modules can improve conceptual understanding, which further supports this.

4 Conclusion

Based on the results of research and discussion of the blended learning-based integrative learning design framework learning model in the learning outcomes evaluation course, it can be concluded as follows: Developing an integrative learning design framework learning model based on blended learning in the learning outcomes evaluation course, the learning stages are carried out according to the model developed as follows: (a) Identifying Learning Objectives; (b) Learning Material Design; (c) Face-to-Face Learning; (d) Online Learning; (e) Assignments and Projects; (f) Collaboration and Discussion; (g) Continuous Feedback; (h) Final Evaluation; (i) Reflection and Self-Assessment; and (j) Continuous Update and Development

The blended learning-based integrative learning design framework learning model used in the learning outcomes evaluation course is very poor. The integrative learning design framework based on blended learning is used in very practical learning outcomes evaluation courses.

The learning model is an integrative learning design framework based on blended learning in improving learning outcomes in very high learning outcomes evaluation courses. 0.63 in the "moderate" category ($0.7 > \text{(N-gain)} \geq 0.3$), so it is very effective in improving student learning outcomes. The numerical ability and competency of the student learning outcomes evaluation course is very high, namely there is an increase of 42.16.

References

[1] Garrison & Vaughan (2008), / Garrison, D. R., & Vaughan, N. D., (2008). *Blended Learning in Higher Education : Framework, principles and guidelines.* San Fransisco: Josey-Bass

[2] Ningsih, Y., L. (2015). *Aplikasi Blended Learning pada Pembelajaran Kalkulus 1 di Universitas PGRI Palembang.* http://www.univpgri.palembang.ac.id/e_jurnal/index.php/prosiding/article/downl

[3] Suryani, N. (2013). Improving Quality of Learning at University Through Application of Blended Learning : a case study at sebelas maret university, Solo, Indonesia. (Versi Elektronik). *International Journal of Education and Research, 1,* 1-12

[4] Leoni, Agustin. 2008. Pintar Psikotes dan TPA. Tangerang: PT. Tangga Pustaka

[5] Suparlan, A. J. (2009). Pengaruh minat dan kecerdasan numeric terhadap prestasi belajar matematika siswa. *EduMa, 1*(2), 129-137.

[6] Astuti, Y. & Setiawan, B. (2013). “Pengembangan Lembar Kerja Siswa (LKS) Berbasis Pendekatan Inkuiri Terbimbing dalam Pembelajaran Kooperatif pada Materi Kalor”. *Jurnal Pendidikan IPA Indonesia. 2* (1), hlm. 88-92.

[7] Arifin. (2013). *Evaluasi Pembelajaran*. Bandung: PT. Remaja Rosdakarya.

[8] Dabbagh, N., Ritland, B.B. (2005). *Online Learning : Concept, Strategies, and Appliclation.* New Jersey : Pearson Merril Prentice Hall.

[9] Hew, K. F., & Cheung, W. S. (2014). *Using blended learning: Evidence-based practice*. New York: Springer. http://dx.doi.org/ 10.1007/978-981-287-089-6

[10] Kaur, Manjot. (2013). “Blended Learning-Its Challenges and Future”. Proceding of Social and Behavioral Sciences 93, *In the Science Direct*, http://www.sciencedirect.com/science/ article/pii/S187704281303351X

[11] Gaol, F. L., & Hutagalung, F. (2020). The trends of blended learning in South East Asia. *In Education and Information Technologies (Vol. 25*, Issue 2, pp. 659–663). Springer. https://doi.org/10.1007/s10639-020-10140-4
[12] Atmacasoy, A., & Aksu, M. (2018). Blended learning at pre-service teacher education in *Turkey: A systematic review. Education and Information Technologies,* 23(6), 2399–2422. https://doi.org/10.1007/s10639-018-9723-5
[13] Castro, R. (2019). Blended learning in higher education: Trends and capabilities. *Education and Information Technologies, 24*(4), 2523–2546. https://doi.org/10.1007/s10639-019-09886-3
[14] Kabassi, K., Dragonas, I., Ntouzevits, A., Pomonis, T., Papastathopoulos, G., & Vozaitis, Y. (2016). Evaluating a learning management system for blended learning in Greek higher education. *SpringerPlus, 5*(1), 1–12. https://doi.org/10.1186/s40064-016- 1705-8
[15] Lim, C. P., Wang, T., & Graham, C. (2019). Driving, sustaining and scaling up blended learning practices in higher education institutions: a proposed framework. *Innovation and Education, 1*(1), 1–12.
[16] Eduka, T.M., Kusama, A., Nurhayati, S., dan Punjabi, E. (2012). *Ujian Masuk Favorit Program SBI & Akselerasi*. Surabaya: Genta Group Production
[17] Soemanto, W. (2003). *Psikologi Pendidikan*. Jakarta: PT. Rineka Cipta
[18] Ismoro, D. (2014). Hubungan Antara Kretivitas dan Kemampuan Numerik dengan Kemampuan Kognitif Fisika Siswa SMP Kelas VIII. *Jurnal Pendidikan Fisika*, 2(2), 35-39
[19] Indrawati, F. (2013). Pengaruh Kemampuan Numerik dan Cara Belajar Terhadap Prestasi Belajar Matematika. *Jurnal Formatif, 3*(3). 215-223.
[20] Cahyono, T. D., Masykuri, M., & Ashadi. (2016). Kontribusi kemampuan numeric dan kreativitas terhadap prestasi belajar siswa pada materi pokok hidrolisis kelas XI MIA1 dan XI MIA5 SMA Negeri 2 Karanganyar tahun pelajaran 2015/2016. *Jurnal Pendidikan Kimia (JPK), 5*(2), 81-88.
[21] Borg, W R & Gall, M D. (2005). *Educational research: an introduction, Fourth Edition.* New York: Longman. Inc.
[22] Mardapi, Djemari, (2008). Teknik Penyusunan Instrumen Tes Dan Non Tes, Yogyakarta: Mitra Cendikia Press, 2008
[23] Hake, R. (1998). Interactive-engagement versus traditional methods: A sixthousand-student survey of mechanics test data for introductory physics courses. Am. J. Phys, 66(1), hlm. 64-74.
[24] Kariadinata, R. (2010). "Kemampuan Visualisasi Geometri Spasial Siswa Madrasah Aliyah Negeri (MAN) Kelas X Melalui Software Pembelajaran Mandiri". Jurnal EDUMAT. 1(2)
[25] Heinich, Molenda & Russel (1996). TeachingReading Today's In Elementary Schools. Third Edition. Dallas Geneva, Illinois Hopewell, New Jersey Palo Alto: Houghton Mifflin Company Boston. 47
[26] Alessi & Trollip. (2001). Multimedia for learning: Methods and development. Massachusetts: A Pearson Education.
[27] Romiszowski, A. J. (1986). Developing auto instructional materials. New York: Kogan Page Ltd. 406-407
[28] Mayer, Richard E., (2009). Multimedia Learning, Yogyakarta: Pustaka Pelajar.
[29] Rogness, J. (2011). Mathematical Visualization. Journal of Mathematics Education at Teachers College. 2(2): 1–7.
[30] Gambari, A. I., Falode, C. O., & Adegbenro, D. A. (2014). Effectiveness of computer animation and geometrical instructional model on mathematics achievement and retention among junior secondary school students. European Journal of Science and Mathematics Education, 2(2).
[31] Lasmiyati & Harta (2014) Pengembangan Modul Pembelajaran untuk Meningkatkan Pemahaman Konsep dan Minat SMP. Pythagoras: Jurnal Pendidikan Matematika. Vol. 9 (2): 161-174.