Advances in Social Science, Education and Humanities Research, volume 550
Proceedings of the 1st International Conference on Mathematics and Mathematics Education (ICMMED 2020)

Validation of Teaching Materials for the Blended Learning Model of Applied Mathematics for Polytechnic Student

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ABSTRACT

This study aims to determine the level of validity of applied mathematics electronic teaching materials for the blended learning model in the form of modules (E-Modules) and student activity sheet (E-SAS). The research used the 4D model development method, carried out at the Politeknik Negeri Bali (PNB). Data were collected using validation sheets, student response questionnaires and analyzed descriptively. The results of the analysis show that the E-Module and E-SAS applied mathematics are quite feasible, very practical and very useful for blended learning models. E-Module and E-SAS need to be refined. The development process can be continued to the stage of effectiveness testing, evaluation and dissemination. But before that it needs to be refined.

Keywords*: Validation, E-Module, E-SAS, Applied Mathematics, Blended Learning.*

I. INTRODUCTION

The era of the industrial revolution 4.0 in information technology has become the basis of human life in the world [1]. Information technology is developing very rapidly and has a significant impact on all aspects of life. Higher education is the highest education with the responsibility of preparing Indonesian people to have superior potential, mastery of science and technology. Facing the challenges of developing information technology, universities are required to prepare quality graduates who are able to compete globally and master technological developments [2].

In early March 2020, the world was shocked by the emergence of the COVID 19 pandemic which has changed almost the entire system of human life. The Covid-19 pandemic has forced every activity to stop, including learning activities in universities. Learning in the era of the industrial revolution 4.0 and during the Covid 19 pandemic must be able to make the learning process continue without space and time limits. Universities are required to be able to organize online learning or e-learning [3]. All tertiary institutions that previously conducted face-to-face lectures on their respective campuses now have to adapt the e-learning or online learning model. All stakeholders must prepare all online learning tools [4]. Lecturers are required to innovate to change face-to-face lecturing patterns into full online recovery patterns through e-learning.

According to Achdiani [5], learning in higher education should prioritize improving the quality of the process creatively, comprehensively and competitively. Higher education is required to be able to organize online learning or e-learning. Lectures are held with scenarios that can prevent physical contact between students and lecturers and students and students [6]. The lecture process is carried out using e-learning, which is considered to be the only medium for delivering material between lecturers and students in this emergency period. E-learning is a form of delivering conventional learning that is poured into digital format via the internet [7]. E-learning is able to bring together students and lecturers to carry out learning interactions with the help of the internet [8]. Learning with e-learning has a level of effectiveness / success is at least the same as face-to-face learning [9]. Learning in the era of the industrial revolution 4.0 also requires e learning[10].

The use of e-learning is used as a learning solution during the 2019 Covid pandemic. However, behind its

excellence, there are a number of obstacles. The biggest obstacle to e-learning is direct interactivity between students and their instructors, learning is a two-way process. Students need feedback from the teacher and vice versa, teachers also need feedback from students [11]. On the other hand, Indonesia's diverse regions mean that not all areas are covered by internet services and the distribution of the internet network is slow at times [12]. The ability of parents to provide online education facilities [13] . Using the internet network costs money [14,15]. It was found that there was a mismatch with what should have been, many thought that the responsibility of teachers in implementing e-learning was lighter than traditional learning [16].

The learning process is not just a transfer of knowledge, but also a transfer of values that is reflected in the direct interaction between lecturers and students. The process of interaction between lecturers and students, and between students and students is very necessary in building character and human aspects. Learning through e-learning is able to bring distant things closer, but often distance them. To complement each other between e-learning learning and conventional learning, a Blended Learning model can be used. Blended learning can be a solution to overcome the weaknesses of e-learning pursuit [11,17]. Blended learning is considered capable of bridging the demands of information system progress that is growing very rapidly and the demands to maintain noble values or national character [18]. Blended learning uses an approach that empowers various other sources of information, as a method that creates a learning environment suitable for students in tertiary institutions [19], which is one of the elearning learning innovations to obtain better output learning.

Blended learning is also understood as a learning environment that integrates various ways of presentation, as a result of the adoption of a strategic and systematic approach to technology use combined with the best features of face-to-face interactions [20]. Blended learning is preferred over traditional classes because blended learning provides satisfaction in learning [21,22,23,24]. Combining the advantages of traditional learning models and digital-based learning models (e-learning) will have a good effect on the learning process [25,26,27,28]. Blended learning is proven to be effective in improving the quality of learning outcomes. Blended learning has a positive impact on student academic achievement at Jordan [29]. Bended learning is effective in assisting students in learning English grammar [30]. In science learning, it can have a positive impact on learning outcomes, skills, attitudes and learning outcomes can reach the highest level [31]. In blended learning, students can learn more effectively in an integrated learning[30] environment [32]. The Blended Learning model can improve students' understanding [33]. The prerequisite for the learning device has been well prepared by the teacher [34].

The use of media and learning resources is part of the components that affect the quality of learning activities. Every learning activity requires an attractive medium and learning resource for students. Teaching materials need to be adapted to the conditions of students and the learning strategies used by the lecturers. Teaching materials are information, tools and texts needed by the teacher / instructor for planning and reviewing the implementation of learning [35]. Teaching materials are means or learning tools that contain materials, methods, limitations, and ways of evaluating learning that are designed systematically and attractively in order to achieve expected goals. Some media that really need to be developed are interactive teaching materials in the form of modules and Students Activity Sheet (SAS).

The module is equipped with instructions for self-study, so that students can study according to their abilities and can fulfill all competencies that must be mastered by students. Modules are learning tools or tools that contain materials, methods, limitations, and ways of evaluating which are designed systematically and attractively to achieve the expected competencies according to the level of complexity [36,37]. Modules are different from textbooks and textbooks. Modules are teaching materials in printed form that are arranged systematically into the smallest learning unit to achieve certain learning objectives [38,39,40,41]. While the student activity sheet (SAS) is a printed teaching material in the form of a sheet containing assignments which contains instructions, steps for completing assignments [42], SAS is teaching material that has been packaged in such a way that students are expected to learn the teaching material independently [39].

With advances in technology, printed teaching materials can be made flexibly without requiring a lot of money. Modules and E-SAS can now be transformed electronically, called E-Modules and E-SAS, namely modules and E-SAS that are formed in digital form, so they can be carried anywhere, can be read, studied anywhere without the need for special space. E-modules and E-SAS are learning tools that contain materials, methods, limitations and ways of evaluating which are arranged systematically and attractively to achieve the expected competencies [43]. With the help of various digital advancements, E-modules can be stored and read in electronic communication storage (smartphones). If the module and SAS in printed form can only insert pictures and graphics, E-modules and E-SAS can be inserted. Audio, video animation or learning that explains a real problem, so that it can enrich the learning experience of students. The e-module can also be equipped with a self-evaluation. Can be presented in PDF format and Ms Word can overcome the weaknesses of printed modules and SAS. E-Modules and E-SAS can also be used independently by students either at home or on campus using a computer or laptop [44]. Both can be used for offline learning (outside the network), students do not have to meet face to face, lecturers just need to share certain links with students. Students can save it automatically on their respective devices. They only need to learn independently following the learning instructions made by the lecturer, they can also reflect on learning and can have deeper discussions when

they meet on a limited basis. The application does not require an internet connection.

The use of E-modules and E-SAS in the learning process provides advantages, one of which is that lecturers can control the digital-based student learning process. Lecturers can provide teaching not only in the classroom, but also outside the classroom. Lecturers can also control the content of teaching materials according to the ability level of students and according to the competencies expected by the curriculum [45]. The real effect in the Blended Learning model is to increase student motivation, student independence in this case students in learning mathematics and increase the effectiveness of the learning process [46,47,48,49]. Student learning outcomes using interactive e-module media are declared complete student responses to the use of interactive e-module media in the learning process in good categories [50]. Android-based interactive e-modules are effectively used to improve student learning outcomes in the learning process [51]. So far, there is no teaching material that is in accordance with the learning paradigm demanded by the 21st century education paradigm and the COVID-19 pandemic. Lecturers are still teaching based on hand out based on conventional curricula even though online learning. On the other hand, teaching materials have a very important role in every education system around the world [52,53]. Teaching materials have been placed in a very special position in the educational process [54,55, 39].

Utilization and empowerment of digital teaching materials such as E-Modules and E-SAS based on blended learning to support learning is a necessity, not only to increase the effectiveness and quality of learning, but more importantly to increase mastery of the material for both lecturers and students [56]. The use of appropriate teaching materials in the learning process can increase student activity in learning [39]. Teaching materials and blended learning play a very important role in supporting the development of education so that when these two things are combined it can be believed that the E-Module and E-SAS based on blended learning can educate students to live in the digital era and the Covid-19 pandemic. The research aims to determine the feasibility, practicality and usefulness of applied mathematics digital teaching materials in the form of E-Modules and E-SAS for the blended learning model.

II. RESEARCH METHOD

This research is a development research using a 4-D model including the stages: 1) Define, 2) Design, 3) Develop, and 4) Disseminate. Implementation in the field of engineering at the Politeknik Negeri Bali(PNB), for 3 years. Currently, the second year (2020) is limited to a validation and trial process. Samples were taken using proposive sampling from 196 people distributed in 3 departments and 6 study programs. the Disseminate stage will be carried out in the third year (2021).

The define and design stage is the stage of development needs analysis. At this stage, a field survey and literature review are carried out. The field survey was conducted on students and lecturers in the field of PNB engineering, which is related to the availability of internet facilities, student characteristics in learning, and student perceptions of current applied mathematics teaching materials. Then the draft I E-Module and E-SAS Applied Mathematics for the blended learning model were constructed. The selection of the content of the material is based on the principles of developing teaching materials in general with attention to the problem of coverage or scope, depth and order of presentation. The order of presentation uses a procedural or hierarchical approach. Furthermore, it was developed using the Flip PDF application and integrated into the Schoology model LMS. This stage has been carried out in the first year (2019).

Develop stage, to get a validated draft of II E- Module and E-SAS. This stage is carried out through: 1) expert appraisal, 2) revision, and 3) developmental testing. Currently only the validation and testing phase is being carried out. The assessment is carried out by filling out a validation questionnaire on the design aspects of Draft I. Meanwhile, the dissemination stage is the use of products that have been developed on a wider scale such as classes and other lecturers. The goal is to test the effectiveness and evaluation of the E-Module and E-SAS. The dissemination stage will be carried out in the third year (2021).

Data were collected using methods: survey, observation and interviews. The instrument is compiled by the researcher based on the variables which are translated into research indicators. The answer for each instrument item using a Likert scale has a gradient from very positive to very negative. Furthermore, the data were analyzed using descriptive statistics. The validity of the model is determined by the suitability of the validation results with the specified validity criteria. According to Akbar, one of the criteria that can be used is as in Table 1 below [57].

TABLE 1 THE CRITERIA FOR THE VALIDITY OF THE LEARNING MODEL

No	Validity Criteria	Level of validity
1	85.01 % – 100 %	Very valid, or can be used without revision
2	70.01 % – 85.00 %	Quite valid, or can be used but needs minor revisions
3	50.01 % – 70.00 %	Less valid, or suggested not to be used because it needs major revisions
4	01.0 % – 50.00 %	Not valid, or may not be used

III. RESULTS AND DISCUSSION

This research is a development research using the 4-D model, carried out multi years for 3 years. The first stage of this year (2019) needs analysis, namely defining and designing. Has obtained draft I E-module applied mathematics product, using the Flip Maker Pdf application.

The draft of applied mathematics teaching materials based on blended learning, the material refers to the KKNI curriculum, the material is divided into 2 E-Module and E-SAS. Applied Mathematics E-Module and SAS I and II. Applied Mathematics E-Module and SAS I, including: Algebra, Geometry, and Trigonometry. Applied Mathematics E-Module and SAS II, namely Calculus include: limits, differentials and integrals. The selection of materials is based on the principles of: relevance, consistency and sufficiency. The depth refers to the aspects contained in learning outcomes, course learning outcomes, and learning sub-achievement, while the description is based on a hierarchical approach. The material is integrated into the learning management system (LMS) schoology model. The delivery approach used problem-based learning. Learning evaluation uses a test form that is packaged in a competency test at the end of each sub-chapter and chapter.

The E-Module and E- SAS that has been constructed is called draft I, then theoretically validated by 5 validators, namely: learning content expert, learning design expert, media expert, users and peers. The recapitulation of the results of each validator's assessment is presented in Table 2.

TABLE 2 RECAPITULATION OF THE RESULTS OF EXPERT VALIDATION ON BLENDED LEARNING-BASED MATHEMATICS E-MODULE AND E- SAS

No	Experts/Users	E-Module		E-SAS	
		Persentage	Category	Persentage	Category
1	Content of Learning	82.6	Quite valid	82.3	Quite valid
	Media	81.9	Quite valid	83.4	Quite valid
2	Design	83.3	Quite valid	84.6	Quite valid
4	Users	84.5	Quite valid	85.6	very valid
5	Peers	87.5	valid	86.5	Quite valid
	Average	84.0	Quite valid	84.48	Quite valid

Based on table 2, the assessment of learning content included an assessment of the concepts presented in textbooks and worksheets, namely concepts; real number operations, graph functions, equations and inequalities, trigonometric functions, trigonometric identities, sine and cosine rules, double angles, trigonomic equations, limit functions, limit algebraic functions, limit trigonomic functions, limit infinity, continuity functions, derivative functions, derivative functions implicit, exponential dirivative, derivative of logarithmic functions, derivative of trigonometric functions, derivative of syclometric functions, maximum and minimum values, partial derivative, uncertain integrals and certain integrals. The results of the evaluation of learning content experts showed that 82.6% and 82.3%. The draft I E-Module and E-SAS applied mathematics for blended learning in terms of its content is quite feasible to used by making small revisions according to the input suggestions of the validator.

Validation of learning media, including assessment of illustrated images, graphics and video tutorials contained in E-Module and E-SAS. The results of the evaluation of instructional media experts showed that 81.9% and 83.4%. In terms of the learning media, the draft of E-Module and E-SAS applied mathematics based on blended learning is quite feasible to use by making small revisions according to the input suggestions of the validator.

Validation of learning designs, including assessment of introductions, learning indicators, learning content, summaries, tests, answer keys, others such as system or format, font size, book size, and appearance. The results of the evaluation of instructional media experts showed 83.3% and 84.6%. In terms of design, the draft I E-Module and E-SAS applied mathematics based on blended learning is quite feasible to use by making small revisions according to the input suggestions of the validator.

Assessment from users and peers to determine the level of practicality. Assessment aspects include: characteristics, title page, preface, introduction, learning indicators, material description, summary, test, and feedback. The results showed that 86.0% and 86.1%. The draft I E-Module and E-SAS applied mathematics based on blended learning in terms of practicality are very practical to use as teaching materials.

Based on the recapitulation of the results of each expert's assessment of the draft E-Module and E-SAS, the average score of 84.0% and 84.48% is categorized as quite valid. The draft E-Module and E-SAS applied mathematics based on blended learning is quite feasible to use by making small revisions according to the input suggestions of the validator.

Taking into consideration the suggestions given by each validator, the draft I was revised to get draft II, then carried out individual, small group, large group, and field tests. The goal is to get direct input from lecturers and students on draft II. The testing involved students and lecturers in the field of technology. A recap of the test results is presented in Table 3.

TABLE 3 RECAPITULATION OF TRIAL RESULTS ON BLENDED LEARNING-BASED MATHEMATICS E-MODULE AND E- SAS

No	Trials	E-Module		E-SAS	
		Percentage	Category	Percentage	Category
1	Individual	84.6	Quite valid	83.9	Quite valid
2	Small group	83.6	Quite valid	86.7	very valid
3	Large group	87.6	Very valid	88.7	very valid
4	Field test	85.8	Very valid	87.8	Very valid
	Average	85. 4	Very valid	86. 8	very valid
5	Limited	88.9		86.8	very meaningful

Based on the results in table 3, the test results for draft II are declared very valid, draft II is declared very feasible as teaching material, can be continued to the next testing phase, namely limited trials. The aim is to determine the level of meaningfulness of E-Module and E-SAS that are being developed. The test involved 196 students in the second semester in the field of technology. The student's response showed that the usefulness of the E-Module and E-SAS reached 88.9% and 86.8%, meaning that the teaching materials developed were very useful for students so that this teaching material can be carried out through testing the effectiveness, evaluation and dissemination stages. This process will be carried out at the stage of the following year. But before that, for its perfection, it is necessary to make small revisions, especially with regard to graphics.

IV. CONCLUSION

The feasibility level of applied mathematics E-Module reaches 84.0%, practicality reaches 86.0% and the usefulness reaches 88.9%. Meanwhile, the feasibility level of E-SAS reached 84.48%, practicality reached 86.18%, and the usefulness reached 86.8%. E-Modules and E-SAS Applied Mathematics are quite feasible, very practical and very useful to be used as teaching materials for applied mathematics for blended learning models. However, for the perfection of these two teaching materials it is necessary to make small revisions, especially with regard to graphics. The implication is that after revision of draft II of the two teaching materials, it can be continued to the next development stage, namely effectiveness and dissemination testing in the third year (2021)

ACKNOWLEDGMENT

The author expresses high appreciation and thanks to the editor and the Directorate General of Higher Education of the Ministry of Education and Culture who have funded this research through the 2020 Higher Education Leading Applied Research program (continued), contract number: 789 / PL8 / AMD / LT / 2020

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