

Research Article

Validity, Practicality and Effectiveness of E-module Teaching Materials in the Learning Subject Applied Mathematics in Students

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ORCIDFitriani Halik: <https://orcid.org/0009-0000-0205-887X>**Abstract.**

As the study of mathematics is quite vast, the lecturer requires open interactive materials so that students can better understand, especially in the process of solving problems in learning mathematics. This can be overcome by improving learning materials supporting students problem-solving abilities, one of which is using an e-module. This research aims to determine the validity, practicality, and effectiveness of e-modules for applied mathematics courses for students. This research used a 4D development model. The development procedure in this research consists of 4 stages namely define, design, develop, and disseminate. This research uses several collection instruments, namely validation sheets, lecturer response questionnaires, student response questionnaires, lecturers' ability observation sheets in managing learning, student activity observation sheets, and student achievement test. The research results show that the validity of the e-module shows a score of 4.8 which is in the very valid category. The lecturer response questionnaire showed a score of 95% and the student response questionnaire showed a score of 94.5% so it was in the very positive category. The lecturer's ability sheet in managing learning is at a score of 4.85, the student activity sheet shows a score of 80.2% and the learning achievement test is 93%. So, it can be concluded that the e-module is valid, practical, and effective.

Keywords: valid, practical, effective

1. Introduction

Education has a very important role for the integrity and survival of society. Education is a means to preserve and improve human life in a beautiful, peaceful, open and democratic manner so that it can produce skilled, capable, competitive and compatible human resources for a generation [1]. Education has a very central role in improving the quality of human resources. Improving the quality of education is an effective effort to shape better human character [2] Considering its importance education in the country, as well as learning in education, is necessary guidelines are prepared to formulate educational goals for educators [3]. In learning mathematics, students are required to develop their skills such as systematic, logical, creative, critical, consistent and holistic thinking

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and behavior sustainable problem solving. When studying mathematics, students are required to be able to focus on solving a problem, thus learning mathematics must be planned in such a way and have problem solving abilities students can improve [4].

Higher education is the highest learning institution known as lectures, in a learning process, lecturers have an important role in conveying material so that students can understand it. One of The course in the graphics engineering study program is applied mathematics. Applied mathematics relates to the application of mathematical concepts necessary for engineering student. The study of applied mathematics is very broad, so the lecturer requires open, interactive materials so that students can better understand the material which is presented especially in the process of solving problems in learning mathematics. In solving mathematical problems, students often experience difficulties so that solving problems results in errors [5]. This can be overcome by improving learning materials supporting students' problem solving abilities, one of which can be based on E-module [6]. With the E-Module, lecturers can do it utilize digital technology as a teaching tool to improve his mathematical knowledge through the use of electronic teaching materials, which can be audiovisual, audio, film and related learning materials, the use of which It is intended to be easy to understand and uses good learning materials [7].

The results of research conducted by Ihwatul Islahiyah (2021) shows that in the use of E-Modules in Mathematics Learning Very valid, effective and efficient. and is very suitable for high school students to study XI. Based on usage tests, E-Module is very effective in improving problem solving abilities, and 80% of students have classical skills. Based on this background explanation, the researcher can develop the next development research idea with the title "Development of Mathematics Module E Teaching Materials in Applied Mathematics Courses to Improve Problem Solving Ability in Students.

Currently, there has been a lot of research examining the development of mathematics modules, so researchers are trying to develop modules in electronic form so that with this e-module it is easier and more practical for students to access learning wherever they study. The problem formulation in this research is how the process of developing e-modules on the eye applied mathematics lectures to improve problem solving abilities in students who are valid, practical and effective.

2. Material and Methods

This research uses the type of research and development. Research and Development is a research method used to produce a particular product, and test the effectiveness of the product [8]. The resulting product is in the form of e-module teaching materials on applied mathematics material. This research is located at the state polytechnic of creative media Makassar. This material was tested on 15 students in the graphics engineering study program for the 2022/2023 academic year. The material that will be tested is material in the applied mathematics course for 1 semester which includes the basics of arithmetic, algebra, linear equations and systems of linear equations and trigonometry. This research used 4D development model. The development procedure in this research consists of 4 (four) stages namely define, design, develop and disseminate. This research uses several collection instruments, namely validation sheets, lecturer response questionnaires, student response questionnaires, lecturers' ability observation sheets in managing learning, student activity observation sheets, and student achievement test. This research involved two validators, namely a mathematician validator and a media expert validator. The data analysis used is validity data analysis, practicality data analysis and effectiveness data analysis.

3. Result and Discussion

This research used 4D development model. The development procedure in this research consists of 4 (four) stages namely define, design, develop and disseminate. However, the dissemination stage was carried out on a limited basis due to time and cost limitations. The stages of 4D development can be explained as follows:

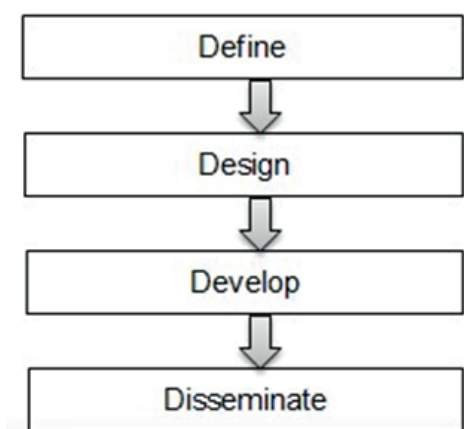


Figure 1: The Model Development Of 4D.

Phase	Activity	Time
Define	The aim of this stage is to determine, formulate and analyze learning needs. In product development, developers need to refer to development requirements, analyze and collect information on the extent to which development needs to be carried out.	May-June
Design	The next stage of developing 4D learning media is the design stage. This design stage aims to design e-module teaching materials that can be used in mathematics learning. The selection of materials, media and formats for prototyping materials is the main aspect of the design stage. At this stage the researcher also designed research instruments in the form of validity instruments, practicality instruments and effectiveness instruments.	June-July
Develop	The development stage is the stage for producing a development product. This development stage aims to produce e-module teaching materials that have been revised based on expert input and trials with students	August-September
Disseminate	The aim of this stage is to disseminate e-module teaching materials. In this research, only limited dissemination was carried out, namely by distributing and promoting the final e-module product on a limited basis to mathematics lecturers at the creative media state polytechnic.	September

Figure 2: 4D Development.

3.1. Define

The first stage is the define stage. The aim of this stage is to determine, formulate and analyze learning needs. In product development, someone needs to refer to the development requirements, analyze and collect information to find out the extent of development that needs to be carried out. Based on the results of analysis and observations carried out at the creative media state polytechnic, it was concluded that the teaching materials used by educators were not optimal and effective, so teaching materials were needed that could improve problem solving for students. At this stage, the researcher carried out curriculum analysis, material analysis and learning objective analysis. As stated by Tsybulsky, what must be done at the define stage is a beginning-to-end analysis, student characteristics and analysis of learning objectives [9].

3.2. Design

The next stage of developing 4D learning media is the design stage. This design stage aims to design e-module teaching materials that can be used in mathematics learning. The selection of materials, media and formats for prototyping materials is the main aspect of the design stage. At this stage the researcher also designed research instruments in the form of validity instruments, practicality instruments and effectiveness instruments. In accordance with Aryuntini's opinion, at the design stage the format and initial product design are selected. The format used is Cambria Math writing format and font size 12. This writing format was chosen because it is suitable for writing mathematical formulas. Apart from that, researchers also created e-module covers that were attractive to readers. Researchers also designed an e-module which

is accompanied by material and mathematical questions based on problem solving in applied mathematics material. Next, the researcher designed a research instrument in the form of a validation sheet that would be used to collect research data.

3.3. Develop

The third stage is the development stage. The development stage is the stage for producing a development product. This development stage aims to produce revised e-module teaching materials based on input from expert validation and student trials. The purpose of expert validation is to determine the level of validity of the teaching materials being developed. The results of the validation analysis can be seen in Table 2 :

Measure Stage	Score	Interpretation
Graphic Validity	4,7	Very Valid
Language Validity	4,9	Very Valid
Construct Validity	4,9	Very Valid
E-Module View	4,7	Very Valid
The Total Of Average	4,8	Very Valid

Figure 3: E-module Validation Test Result.

From table 2 above, it shows that the graphic validity value is at a score of 4.7, the language validity is at a score of 4.9, the construct validity is at a score of 4.9, the e-module view is at a score of 4.7, so that the total of average is 4.8. This shows that the e-module produced is in the very valid category. In line with research conducted by Utami [10] which shows that all forms of learning materials or devices that are validated by experts must be classified as valid. Wibowo & Pratiwi [11] stated that the teaching materials to be used must have valid criteria from expert validators so that they are ready for use. In addition, the resulting e-module can be used with minor revisions of the validator. Revisions are made according to suggestions given by the validator, either given directly or written in the suggestion column.

The suggestions from validators can be seen in Table 3:

From table 4 above, it shows that the student questionnaire response score is at a score of 94.5%, and is in the interval $80\% \leq RN \leq 100\%$ so that the student response

Suggestions	Improvements
The cover of the e-module used must be made more attractive.	Revise the cover of the e-module used to make it more attractive.
The contents of the material in the e-module should be concise and clear.	Make the contents of the material in the e-module concise and clear.
The composition of the material sub-chapters must be systematic.	Make a more systematic arrangement of material sub-chapters.
Writing e-modules should be improved according to the EYD rules.	Adjusting the writing of e-modules according to the EYD rules.
The number of questions in the e-module should be reduced.	Reducing the portion of the questions in the e-module.

Figure 4: E-module Validation Test Result.

Measure Stage	Score	Interpretation
Lecturer's Ability Observation Sheets In Managing Learning	4,85	Very Good
Student Activity	80,2 %	Very Good
Student Achievement Test	93%	Very Good

Figure 5: E-module Practicality Test Result.

questionnaire is in the very positive category. Furthermore, the lecturer response questionnaire score was at a score of 95%, and was in the interval $80\% \leq RN \leq 100\%$ so that the lecturer response questionnaire was in the very positive category. From these two scores it can be concluded that the e-module teaching materials used in applied mathematics material meet the practicality criteria.

Measure Stage	Score	Interpretation
Student Response Questionnaires	4,7	Very Valid
Student Response Questionnaires	4,9	Very Valid

Figure 6: E-module Effectiveness Test Result.

From table 5 above, it shows that the Lecturer's Ability Observation Sheets In Managing Learning score is at a score of 4.85, and is in the interval $4.5\% \leq TKD \leq 100\%$ so that the student response questionnaire is in the very good category. Furthermore, the student activity score is at a score of 80.2%, and is in the interval $80\% \leq RR \leq 100\%$ so that the lecturer response questionnaire is in the very good category. In the test scores,

Student Achievement Test is at a score of 93%, and are in the interval $90\% \leq RR \leq 100\%$ so that the lecturer's response questionnaire is in the very high category. From these three scores, it can be concluded that the e-module teaching materials used in applied mathematics material meet the effectiveness criteria.

3.4. Disseminate

The teaching materials obtained at the final stage of development are then tested and distributed on a wider scale, for example in other classes and at other institutions. However, in this research, the dissemination stage was not carried out perfectly due to time and budget limitations, so it was only distributed to other lecturers for use in other classes and in other study programs in applied mathematics courses.

4. Conclusion

Based on the results and discussion of this research, e-module teaching materials on applied mathematics material were developed using the 4D development model. Based on the validity test, the results obtained show that the graphic validity value is at a score of 4.7, the language validity is at a score of 4.9, the construct validity is at a score of 4.9, the e-module view is at a score of 4.7, so that the total of average is 4.8. This shows that the e-module produced is in the very valid category. Based on the results of the practicality, it shows that the student questionnaire response score is at a score of 94.5%, and is in the interval $80\% \leq RN \leq 100\%$ so that the student response questionnaire is in the very positive category. Furthermore, the lecturer response questionnaire score was at a score of 95%, and was in the interval $80\% \leq RN \leq 100\%$ so that the lecturer response questionnaire was in the very positive category. From these two scores it can be concluded that the e-module teaching materials used in applied mathematics material meet the practicality criteria. Based on the results of the effectiveness, it shows that the Lecturer's Ability Observation Sheets In Managing Learning score is at a score of 4.85, and is in the interval $4,5 \leq TKD \leq 5,0$ so that the student response questionnaire is in the very good category. Furthermore, the student activity score is at a score of 80,2%, and is in the interval $80\% \leq RR \leq 100\%$ so that the lecturer response questionnaire is in the very good category. In the test scores, Student Achievement Test is at a score of 93%, and are in the interval $80\% \leq RR \leq 100\%$ so that the lecturer's response questionnaire is in the very high category. From these three scores, it can be concluded that the e-module teaching materials used in applied mathematics material meet the

effectiveness criteria. So it can be concluded that the applied mathematics e-module teaching materials developed meet the criteria of being valid, practical and effective. Currently, there has been a lot of research examining the development of mathematics modules, so researchers are trying to develop modules in electronic form so that with this e-module it is easier and more practical for students to access learning wherever they study. This is what makes this research different from previous research. The development of e-module teaching materials should be developed for other materials so that they can make students more active and more interested in studying mathematics.

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