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AN EXPLORATORY STUDY: DEVELOPMENT OF ELECTRONIC MODULES IN MATHEMATICAL PHYSICS I COURSE

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ABSTRACT

Abstract is written using Sylfaen letters, size 11, space 1 with a maximum text length of 165 words. Abstracts are written in the standard Indonesian version with enhanced spelling. Abstracts are also written in the English version with applicable conditions. Abstract contains objectives, methods, results and conclusions. This research is an exploratory type of research that aims to find out the difficulties experienced by students in mathematics physics lectures and solutions to overcome them. The method used is quantitative and qualitative research methods with data collection instruments in the form of questionnaires and interview sheets. The number of samples set by the researchers amounted to 30 students as the subject of distributing the questionnaire and 10 students as the subject of the interview. The sample in this study was selected by purposive sampling technique. The data analysis carried out by the researcher was using statistics while the data analysis from the interviews was carried out with 3 main activities, namely data reduction, data presentation, and drawing conclusions. The result of this research is that students have difficulty understanding the material in my mathematics lectures because of the use of books that are less varied and the main books used in English and the derivation of formulas are not presented in detail. Therefore, researchers are encouraged to develop electronic modules where 43.3% of students agree and 23.3% of students strongly agree to develop electronic modules in mathematics practicum I lectures.

Keywords: development; electronics module; mathematical physics I

INTRODUCTION

The development of technology that continues to grow from time to time, has had a significant impact on human life, starting from the era of industrial technology, the era of agricultural technology, the era of information technology, and also the era of communication and information technology. (Liao & Kachalia, 2015; Danuri, 2019).. One of the roles of technology is in the learning process that has been widely used by educators with various renewal efforts. (McClelland et al., 2014; Saregar, 2016).. This can be seen from the many new software or applications that have sprung up as tools or media to support the smooth learning process such as animation in software or applications with htlm or flash output forms (Anandari et al., 2019). (Anandari et al., 2019). Various efforts must continue to be made to improve the learning process for the better. (Solihudin, 2018). One of the efforts that can be made to improve the quality of learning is to develop learning media in the form of teaching materials. (Syahrial et al., 2019).

The development of teaching materials for the learning process is needed to improve the quality of the teaching-learning process so that learners can understand concepts through the media developed and can do independent

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learning. (Asmiyunda, Guspatni & Azra, 2018; Czajka & McConnell, 2019).. The developed teaching material media can be presented in electronic form or often called *e-modules.* (Matsun, Ramadhani & Lestari, 2018; Munthe, Silaban & Muchtar, 2019) and tailored to the learning objectives set (Farida et al., 2020). The development of *e-modules* can anticipate the existence of technological developments that continue to grow rapidly because many students prefer to read and access teaching materials through their smartphones (Simamora, Sudarma & Prabawa, 2019). (Simamora, Sudarma & Prabawa, 2018).. Therefore, teaching materials in the form of *e-modules are* needed in this digital era.

E-module is a teaching material that is displayed in electronic or digital format and presented systematically equipped with animation, audio, and video with the hope that learning objectives can be achieved and students can learn independently *E-modules* provide many advantages compared to printed modules, one of which is their interactive nature. (Sari, Jufrida & Pathoni, 2017).. An electronic module or *e-module* that is interactive means a module that has been systematically designed and is certainly interesting with a description of the material, learning methods, and how to evaluate in order to achieve the expected competencies. (Imansari & Sunaryantiningsih, 2017).. Thus, this interactive *e-module* can be used in learning. (Hadianto & Festiyed, 2020).. One of the courses that really needs the development of interactive *e-module* teaching materials is mathematical physics which is a combination of two words, namely the word physics and the word mathematics. (Gunada et al., 2017).

Physics as a science requires understanding in creative and skillful thinking from learners to understand the relationship between physical and mathematical concepts. (Hidayatulloh, 2020). Meanwhile, mathematics is a branch of science that contains discussions about definitions, facts, theorems, and about the correlation of shape and space, and contains models, numbers, and structures that have been organized. (Nur'aini et al., 2017).. Thus, mathematical physics is a course that learns about how to formulate various concepts from physics into mathematical form and be able to solve them. (Gunada et al., 2017). However, there are still many students who do not understand the material in mathematical physics well because they find it difficult to analyze mathematical concepts in an effort to solve existing physics problems. (Erniwati & Busnawir, 2014).. In addition, students have difficulty understanding mathematical physics textbooks that use English as an introductory language such as the book "*Mathematical Method in the Physical Sciences*" due to lack of ability to understand English. (Wahyuni, 2012). Therefore, researchers are encouraged to make efforts to develop an *e-module* teaching material that can be used by physics education students in mathematical physics 1 courses to facilitate students in understanding the material in learning mathematical physics I and improve students' mathematical problem solving skills in order to master concepts in mathematical physics material.

Based on the above description of the preliminary study on the development of electronic modules, the authors have analyzed the needs of electronic modules in physics education students through interviews and distributing questionnaires. Based on the results of the needs analysis, it was found that students had difficulty in learning mathematical physics I due to the use of the main book in English, some students needed time to translate the English book into Indonesian in order to understand the meaning of the material

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described in the book, besides that students had difficulty analyzing mathematical concepts in an effort to solve physics problems. Therefore, researchers are encouraged to develop electronic modules to overcome these difficulties so that they do not occur again.

METHODS

The research conducted by researchers is an exploratory type of research. Exploratory research is preliminary (initial) research with the aim of obtaining an overview of a research topic that researchers conduct further. (Marzoan, 2020; Morissan, 2017). The research methods used are quantitative and qualitative research methods. Quantitative research is a method used in research to collect data and analyze data quantitatively where data is obtained from a collection of samples in a predetermined population. (Mustafa et al., 2020). Meanwhile, qualitative research is a method used to answer research problems related to narrative-shaped data with sources derived from observation, interviews, and document excavation activities. After determining the type of research used, the researcher then prepares the instruments used for research data collection.

The research instruments used by researchers were questionnaires and interview sheets. The interview sheet contains questions about the opinions of physics education students on mathematical physics I courses consisting of 12 questions. While the questionnaire used as a data collection tool is a student needs questionnaire. The questionnaire used by researchers is a type of closed questionnaire so that respondents can directly select and determine the answer options that are considered the most appropriate / according to the respondent based on the existing answer options. (Riany et al., 2016). The number of questionnaire items used consists of 6 positive statements with a Likert scale type of 5 answer options. The Likert scale used has levels from very negative to very positive (Sugiyono, 2014). (Sugiyono, 2014). The following is a Likert scale category for a questionnaire of student needs for mathematical physics e-modules which can be seen in table 1.

Table 1. Likert Scale Categories for Questionnaires of Student Needs for E-Modules of Mathematical Physics I.

Number	Interval	Category
1	6,0 - 10,8	Strongly Disagree
2	10,9 - 15,6	Disagree
3	15,7 - 20,4	Undecided
4	20,5 - 25,2	Agree
5	25,3 - 30,0	Strongly Agree

Based on table 1. It appears that the student questionnaire category consists of categories of strongly disagree, disagree, doubt, agree, and strongly agree with the previously sought scoring intervals. Questionnaires that are ready to be distributed will be given to research respondents who are sampled from the population used.

Population is a collection of people used by researchers with specific characteristics to draw conclusions after being studied beforehand. (Dewi et al., 2019). The population in this study amounted to 91 students from the Faculty of

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Teacher Training and Education, physics education study program, Jambi University, namely from the class of 2019. In this study, researchers did not use all students to serve as samples. The sample is part of the population that is determined as a research subject and is expected to represent the population (Mazen & Tong, 2020). (Mazen & Tong, 2020). The number of samples determined by the researcher amounted to 30 students as the subject of distributing questionnaires and 5 students as interview subjects. The sample in this study was selected using purposive sampling technique.

Purposive sampling is a research sampling technique where the researcher determines the sample set with certain considerations (Sugiyono, 2015). The considerations used for determining the sample are determined based on the needs of the researcher in accordance with the research to be carried out. (Maharani & Bernard, 2018). The consideration that is the basis for sampling by researchers is students who have contracted mathematical physics I courses. After determining the research sample, then the researcher distributes a questionnaire of student needs to sample members to obtain research data / information and then analyzes it and continues by conducting interviews with students and then analyzing the data.

The questionnaire data analysis conducted by researchers is using descriptive statistics. Descriptive statistics are data analysis carried out by describing the data or information obtained quantitatively. (Lasmawan, 2015). Activities in descriptive statistical data analysis are carried out by finding the average value (mean), median, minimum value and maximum value in order to obtain an overview of the characteristics of the data. (Darmaji et al., 2020). Testing in this study was carried out with the help of the IBM SPSS 23 program. Meanwhile, the data analysis of the interview results was carried out with an interactive model consisting of 3 main activities, namely reducing the data obtained, presenting the data obtained, and drawing conclusions/verification (Andani & Yulian, 2018). (Andani & Yulian, 2018).

RESULT & DISCUSSION

The student needs questionnaire will be analyzed after everything is collected. The analysis conducted by researchers is descriptive statistics by looking for the mean (average), median, minimum value and maximum value, frequency and percentage of student perceptions. The following is a table describing the acquisition of the results of a questionnaire of physics education students' needs for the development of e-modules of mathematical physics I in class 2019.

Table 2. Description of the Results of the Questionnaire of Physics Education Students' Needs for the Development of E-Modules of Mathematical Physics I

Category	f	%	mean	median	min	max
Strongly Disagree	0	0%				
Disagree	1	3,3%	22,4	22,5	15,0	30,0
Undecided	9	30,0%				
Agree	13	43,3%				
Strongly Agree	7	23,3%				

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Based on table 2, it is known that the dominant physics education students gave responses in the agreed category for the development of e-modules of mathematical physics I, namely 13 students and a percentage of 43.3%. While other students gave responses in the category strongly agree as many as 7 students, in the category of doubt amounted to 9 students, and in the category of disagree only amounted to 1 student. The average student response to the e-module of mathematical physics I is 22.0 with a median value of 22.5. The minimum value is 15.0 and the maximum value is 30.0.

As for the results of interviews conducted to students related to student responses to mathematical physics I courses are presented as follows:

1. Have you attended the math physics I lecture?
   Answer: Yes, you have. Students have taken mathematical physics I in semester 3.
2. Is this your first time attending a mathematical physics I course?
   Answer: Yes, this is the first time students take mathematical physics I in the physics education study program at FKIP Jambi University.
3. How many times have you attended mathematical physics I?
   Answer: Students attended the mathematical physics I lecture once, namely during semester 3 with 16 meetings.
4. Do you have the literature for the mathematical physics I course?
   Answer: yes, the main literature used is the *mathematical* physics I book entitled "*Mathematical Methods in the Physical Sciences*" written by Mary L. Boas. There is also literature from the Power Point (PPT) given by the lecturer and also literature from the internet.
5. What do you think about the literature used in the mathematical physics I course?
   Answer: The literature used in the mathematical physics I course is sufficient to assist students in learning the material in the mathematical physics I course. It's just that there are still many students who have difficulty in understanding the content of the material contained in the *mathematical* physics I book because the main book used is in English with the title "*Mathematical Methods in the Physical Sciences*" written by Mary L. Boas, and not all students are able to understand English so it takes time to translate into Indonesian. In addition, the derivation of formulas contained in the book "*Mathematical Methods in the Physical Sciences*" is less detailed and the literature used in the mathematical physics I course is still less varied.
6. Did you have any obstacles or problems during the mathematical physics I course?
   Answer: Yes, some students experienced problems in the mathematical physics I course.
7. Does one of the obstacles or problems of mathematical physics I lectures lie in teaching materials?
   Answer: Yes, one of the obstacles experienced by students in mathematical physics I lectures lies in the teaching materials used because the main book used is in English, making it difficult to understand. In addition, students lack references to teaching materials to be used in mathematical physics I lectures.
8. What do you expect from the mathematical physics I teaching materials?

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Answer: What students expect is that there are various teaching materials with an attractive appearance, easier to understand and understand by using the Indonesian language of instruction and there are various examples of problems with a more detailed and detailed decline in the formula so that it is easier to understand.

9. Are you happy if Mathematical Physics I is available as an electronic module?
   Answer: Yes, I am glad that the electronic module used is easy to understand so that it can help in mathematical physics I lectures.
10. What do you think if mathematical physics I is made into an electronic-based lecture module?
    Answer: Very happy because electronic-based modules are a form of technology utilization in today's online era, besides that with the electronic module students can read the module anytime and anywhere so that students don't have to bother carrying thick books, just by opening a smartphone students can read it and study it so that it can support lecture activities.
11. If there is an electronic module of mathematical physics I, do you think it can help the process of mathematical physics I lectures?
    Answer: Yes, it can help the mathematical physics I lecture process if the content is easily understood by students.
12. If there is an electronic module of mathematical physics I, what do you expect from it?
    Answer: What students expect from the electronic module of mathematical physics I is that the module can be a learning resource that supports the process of mathematical physics I lectures and can help students in understanding the material in mathematical physics I lectures, presented completely and clearly with Indonesian language of instruction, there are examples of problems with more detailed explanations to make it easier to understand, and has an attractive appearance and is easy to operate.

Based on the results of the questionnaire that has been analyzed by descriptive tests displayed in table 2, it is known that the percentage of student needs for the development of electronic modules of mathematical physics I in physics education students class of 2019 is dominantly in the agreed category, namely with a percentage of 43.3%. Thus students agree to develop electronic modules in mathematical physics I lectures. The average descriptive test results of the student needs questionnaire on the development of an electronic module of mathematical physics I is 22.4.

Based on the results of the interview, it is known that physics education students class of 2019 have attended mathematical physics I lectures in semester 3 for 16 meetings. The literature used by students in mathematical physics I lectures is a book entitled "*Mathematical Methods in the Physical Sciences*" written by Mary L. Boas. There is also literature from the Power Point (PPT) given by the lecturer and also literature from the internet. Because the main book used is in English, students have difficulty in understanding the content of the material contained in the book, especially for students who are weak in understanding English so that it takes time to translate into Indonesian. In addition, the decrease in formulas contained in the book "*Mathematical Methods in the Physical Sciences*" is not presented in detail and the literature used in the mathematical physics I course is still less varied. Therefore, it

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is expected that students expect a variety of teaching materials with an attractive appearance, easier to understand and understand by using Indonesian language of instruction and there are various examples of problems with more detailed and detailed formula derivation to make it easier to understand. Moreover, if the teaching material is presented in the form of an electronic module, it will make students feel happy because students can read the module anytime and anywhere so that students don't have to bother carrying thick books, just by opening a smartphone students can read it and study it so that it can support lecture activities. Students also expect that the electronic module can be a learning resource that supports the mathematical physics I lecture process and can help students in understanding the material in mathematical physics I lectures, presented completely and clearly with Indonesian language of instruction, there are examples of problems with more detailed explanations to make it easier to understand, and has an attractive appearance and is easy to operate so that it can improve the process and better learning outcomes.

The acquisition of learning outcomes will be good if success in learning is achieved in accordance with the learning objectives that have been set. (Jayul & Irwanto, 2020; Pantic & Wubbels, 2012).. In order for the learning process to be successful, the active role of learners in the learning process is needed. (Kazempour, 2014; Puspita et al., 2018).. One of the things that can be done so that learners are actively involved during the learning process is the role of interactive learning *e-modules.* (Herawati & Muhtadi, 2018; Kuswanto, 2019).. The existence of *e-modules* can make learners not bored quickly in carrying out learning activities, especially in FISMAT course learning.

FISMAT is one of the compulsory courses for physics education students at Jambi University. Therefore, the FISMAT *e-module is* expected to help students in understanding and solving problems in FISMAT learning. So that students have a higher enthusiasm for learning so that they will try to continue learning to understand the problems in FISMAT.

This preliminary study is expected to contribute to the reference of teaching materials for mathematical physics I lectures and can overcome student difficulties in mathematical physics I lectures. This preliminary study will be continued to further research to determine the results and feasibility of the electronic module of mathematical physics I developed.

CONCLUSION

Based on the results and discussion that has been presented, it can be concluded that students have difficulty in understanding the material in mathematical physics I lectures due to the use of the main book which is in the English language so that it takes time to translate it into Indonesian for students who are not very good at English. The decrease in formulas contained in the book "Mathematical Methods in the Physical Sciences" is also not presented in detail and the literature used is also less varied. Therefore, it is necessary to have varied teaching materials with an attractive appearance, easier to understand and understand by using Indonesian language of instruction and there are various example problems with more detailed and detailed formula derivation to make it easier to understand. Based on the results that have been obtained, 43.3% of students agree and 23.3% of students strongly agree to develop electronic modules

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in mathematical physics I lectures.

Therefore, it is further recommended that educators develop learning media as an effort to prevent learning difficulties experienced by students in mathematical physics I lectures from happening again and prevent various possibilities that can have a negative impact on students.

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