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DEVELOPMENT OF E-MODUL BASED ON A PROBLEM BASED LEARNING MODEL TO IMPROVE PROBLEM SOLVING ABILITY AND APPRECIATION OF MATHEMATICS AT SMP DHARMA PANCASILA MEDAN

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Abstract

The objectives of this research are threefold: firstly, to give a comprehensive analysis of the e-modul's validity, practicality, and efficacy in enhancing students' problem-solving skills and understanding of mathematics at SMP Dharma Pancasila Medan. Furthermore, the aim is to enhance students' problem-solving skills by using the e-module that is based on a certain model. Finally, the aim is to enhance students' appreciation of mathematics by using the e-modul based on the model. This study used the ADDIE model of development, which is a customary approach in developmental research. The development approach consists of five steps: analysis, definition, development, implementation, and evaluation. The findings of the two experiments led to the following conclusions: 1) The developed E-module for problem-based learning was determined to satisfy valid, practical, and effective standards for enhancing students' problem-solving abilities and understanding of mathematics; 2) The N-gain value in trial I was 0.36, which rose to 0.40 in trial II, classifying it as "medium"; and 3) The N-gain value in trial I, which increased to 0.32 in trial II, also falls into the "medium" category for improving students' appreciation of mathematics through its utilisation.

Keywords: E-Modul, ADDIE Model, Problem-Based Learning Model, Problem Solving, Appreciation Mathematics

Abstrak

Tujuan penelitian ini ada tiga: pertama, memberikan analisis komprehensif mengenai validitas, praktikalitas, dan kemanjuran e-modul dalam meningkatkan kemampuan pemecahan masalah dan pemahaman matematika siswa di SMP Dharma Pancasila Medan. Selanjutnya tujuannya adalah untuk meningkatkan kemampuan pemecahan masalah siswa dengan menggunakan e-modul yang didasarkan pada model tertentu. Terakhir, tujuannya adalah untuk meningkatkan apresiasi siswa terhadap matematika dengan menggunakan e-modul berbasis model. Penelitian ini menggunakan model pengembangan ADDIE yang merupakan pendekatan yang lazim dalam penelitian perkembangan. Pendekatan pengembangan terdiri dari lima langkah: analisis, definisi, pengembangan, implementasi, dan evaluasi. Temuan dari kedua percobaan tersebut menghasilkan kesimpulan sebagai berikut: 1) E-modul untuk pembelajaran berbasis masalah yang dikembangkan dinyatakan memenuhi standar yang valid, praktis, dan efektif untuk meningkatkan kemampuan pemecahan masalah dan pemahaman matematika siswa; 2) Nilai N-gain pada uji I sebesar 0,36, meningkat menjadi 0,40 pada uji II, tergolong “sedang”; dan 3) Nilai N-gain pada uji coba I yang meningkat menjadi 0,32 pada uji coba II juga masuk dalam kategori “sedang” untuk meningkatkan apresiasi siswa terhadap matematika melalui pemanfaatannya.
Kata kunci: Pengembangan E-Modul, Model ADDIE, *Problem Based Learning*, Pemecahan Masalah, Apresiasi Matematika

INTRODUCTION

In an era of increasingly sophisticated technological development, the development of technology-based learning is to be increasingly utilized to create innovations that are interesting and enjoyable in the learning process. Curriculum frameworks in some countries include the cultivation of problem-solving skills as a key objective, emphasising the importance of these abilities (Sabaruddin, 2019:26). Ruseffendi (2006:341) asserts that problem-solving skills are crucial in mathematics, not only for those pursuing academic or

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professional involvement in the field, but also for their applicability in several disciplines and everyday situations.

Polya (1973:5) categorises problem-solving skills into four modified indicators: 1) comprehension of the issue, 2) formulation of a solution plan, 3) execution of the problem-solving process as per the plan, and 4) evaluation and revision of the technique and solution outcome. However, research indicates that students' mathematical problem-solving skills are still not meeting the expected standards. In Rambe's research (2020:176), the students performed poorly on the given tasks, especially in terms of the indicators that assessed their responses.

From Cho & Kim's research, (2020) found that students have difficulty in identifying and organizing the information needed to resolve the problem and students do not reevaluate the suitability of the final solution obtained. The results of a research interview with Mr. Rivan Ambiya, S.Pd as a mathematics teacher in the eighth grade of High School Dharma Pancasila Medan confirmed that the ability to solve mathematical problems of students in particular on SPLDV material can not be said well in classical terms. Nasution & Yerizon, (2019) said that children still lack sufficient educational resources to cultivate the ability to systematically tackle problems. Researchers are therefore interested in raising problem-solving skills as one of the mathematical skills that needs to be improved.

One of the important attitudes in mathematics is the attitude of appreciation for math. In support of this, Sholihah and Mahmudi (2015: 177) also revealed that student success in a lesson depends heavily on their attitude to the lesson. The fact revealed that problem-solving skills and students' appreciation of mathematics are not optimum. However, It is hypothesised that students may enhance their learning outcomes, including their problem-solving skills and emotional state, as they go through mathematics courses. Therefore, education is crucial for bridging the disparities. An e-Module is a digital representation of a printed module that can be viewed and generated using certain software on a computer. (Maryam, Masykur, & Andriani, 2019). Like research (Wibowo & Pratiwi, 2018), learning with modules enables students to improve their learning activities optimally according to their level of ability so that students can be directed to focus their attention on problems and find alternatives in their resolution. In order to enhance students' problem-solving skills, the next

e-modules should include issue-based learning. Senada devised a problem-based learning (PBL) paradigm to impart critical thinking skills and problem-solving abilities to students (Scolastika, et al., 2014).

The problem-based learning model, as described by Najwa and Sabariman (2021), is an educational approach that exposes students to various real-world problems. The objective is to foster the development of their problem-solving abilities and, at the same time, improve their ability to apply acquired knowledge in practical situations. However, the e-modules developed in the previous research have not developed e- modules through the problem based learning model and are not oriented to improve the ability to solve problems and mathematical appreciation. So, based on the background that has been outlined above, then the researchers are interested in doing research by developing e-Module based on problem-based learning model to improve problem-solving ability and appreciation of mathematics.

METHODS

Subjects in this study are students of the eighth grade at SMP Dharma Pancasila Medan in the school year 2023/2024. The objective of this project is to construct e-modules that use the problem-based learning paradigm as a basis for educational materials. Research and development focuses on this particular field of study. The objective of research and development is to create and improve a product. The ADDIE development paradigm was used as the basis in this example. The model, according to its name, consists of five main phases, namely (A) analysis, (D) design, (d) development, (I) implementation, and (E) evaluation. Using this model, the researchers will develop an E-Module based on the PBL model. The aim of data analysis in this research is to find out the validity, practicality and effectiveness of e-modules based on problem based learning.

The feasibility data analysis technique uses scores obtained from the Likert Scale. In this study, 4 scales were used with the aim of avoiding answers 3, neutral, or sufficient which tend to be chosen by respondents and assessors. If it is in the valid category $(2{,}50 \leq V_a < 3{,}25)$, then the e-module is suitable for testing in the field after making improvements if there are constructive suggestions from the validator.

Teacher and student responses in this research are considered to meet the practical aspect if they have a student response value of $R \leq 2{,}50$ (good or very good). The e-module

being developed is said to be practical if the average learning implementation is at least in the 'Well implemented' category ($2{,}50 \leq O_k < 3{,}25$).

The effectiveness of the e-module was analyzed from pretest and posttest learning result test data, as well as student appreciation questionnaires for mathematics. Individual completeness is seen from the scores obtained by each student. The success criteria that students must achieve is 75.

Table 1 Level of Mathematical Problem Solving Ability

No.	Value Interval	Category
1	$0 \leq Skor\ Total\ KPMM < 50$	Very Low
2	$50 \leq Skor\ Total\ KPMM < 65$	Low
3	$65 \leq Skor\ Total\ KPMM < 80$	Medium
4	$80 \leq Skor\ Total\ KPMM < 90$	High
5	$90 \leq Skor\ Total\ KPMM < 100$	Very High

(Ulandari, 2019:122)

Meanwhile, classical completion is seen from the number of students who have passed the success criteria score. Classical completion will be achieved if the number of students who achieve the success criteria score is 80%. The N-Gain value is a comparison value between the pretest-posttest score difference and the maximum score-pretest score difference (Hake, 1998). The increase in competency is calculated using the g factor (N-Gain) formula as equation (1):

$$g = \frac{S_{postest} - S_{pretest}}{S_{maks} - S_{pretest}} \qquad (1)$$

The e-module meets the criteria for effectiveness in terms of students' appreciation of mathematics if it meets the criteria for effectiveness, namely the average score from the appreciation questionnaire is $55 < X \leq 71{,}5$ (high).

Tabel 2 Categories of Student Appreciation Level for Mathematics

Value Interval	Category
$\boldsymbol{71,5 < X \leq 88}$	Very High
$\boldsymbol{55 < X \leq 71,5}$	High
$\boldsymbol{38,5 < X \leq 55}$	Low
$\boldsymbol{22 < X \leq 38,5}$	Very Low

(Modification from Wulandari, 2019)

RESULTS AND DISCUSSION

The validity test was carried out to see the shortcomings of the initial design of the e-module developed based on the learning model of the PBL that was designed with the attention of the problems in the class VIII High School Dharma Pancasila Medan. The team of experts (validators) involved in the development of this e-module consists of five experts. The validation results of the five validators stated validity with an average total validity of the e-module in terms of material 3.46 and average 3.37. Then the test results of the instrument test ability to solve mathematical problems and the element of the statement of the lifting Appreciation Mathematics has also been in the category valid based on the test result showing tcount > ttable then the test instrument and the lift can be used and valid. The reliability of the mathematical problem-solving ability test was 0.823 before to the test and 0.818 after the test, indicating a classification in the very high range. (in the highest category). The aforementioned research indicates that the e-module created using the PBL learning paradigm meets the validity criteria established by expert/practitioner assessment.

Then, through the observation sheet of learning performance using the E-Module based on the PBL learning model given to an observer at each test meeting I and II, the results were obtained that observation performance score on test I did not meet the practicality criteria i.e. with the average observation on the first meeting of 2.86; second meeting was 2.93; third meeting was 3.13, with an average of 2.97 (category “insufficiently performed”).

The classical achievement of the mathematical problem solving results of the students in the post-test test test I was 65.21% whereas in the aftertest test II was 82.60% and in accordance with the criteria of classical accuracy of the learners, that is, At least 80% of the students who took the mathematical problem-solving skills test obtained a score of 75 or above. Thus, the result of the after-test of the ability to solve mathematics problems of students meets the classical availability of the material of the linear equation system of two variables.

Based on the analysis of test data I obtained that, the average percentage of the student's mathematical appreciation before receiving treatment was 54,82 and the average class of the students' mathematics appreciation after receiving the treatment was 64,56. In comparison with the data analysis test II the percentages of the average student mathematic

appreciation prior to receiving a treatment was 63,78 and the mean grade of the pupil's Mathematical apreciation after being given treatment was 75,60. Based upon the analysis in chapter III, the data showed that the average score of the learners' Mathematics apreciation before and after learning using the E-Module based on the PBL learning model belonged to the category "sized" (58,9≤X<71,2). It can be concluded that in the test I and the II test of the application of the e-Modul based learning model developed by PBL has already met the criteria for the effectiveness of the Application Module E seen in the mathematic aspects of the participant's training.

Furthermore, Piaget stated the importance of the construction of knowledge by individuals through interaction with the environment. In this case, the PBL model which is the basis for preparing e-modules facilitates this knowledge construction process by placing students in situations where they have to use existing knowledge and find solutions to complex problems. Apart from that, according to Vygotsky, learning occurs when individuals interact with other people who are more competent (zone of proximal development). In problem-based learning, students can work collaboratively, expanding their zone of proximal development by interacting with peers or guiding teachers.

The connection between Piaget's and Vygotsky's theories and the use of e-modules based on the PBL model developed is that both emphasize the importance of direct experience, social interaction and student activity in learning. In this context, learning using PBL-based e-modules allows students to be actively involved in solving problems, collaborating with others, and expanding their understanding through interaction with the environment and their peers.

CONCLUSION

The dependability The E-Module, built based on the PBL learning paradigm, has valid categories. The Mathematics Appreciation Angket, including both the pre- and post-test variants, together with the Mathematical Problem Solving Ability Tests, are reliable study instruments. After evaluating the E-Module and analysing the outcomes of seeing how the learning is applied, it has been determined that the E-Module, which is based on the Problem-Based Learning (PBL) model, meets the practicality criteria. The PBL-based learning module has been deemed successful based on three indicators of effectiveness: (1) students'

proficiency in solving mathematical problems, (2) students' positive perception of mathematics, and (3) students' response to the E Module. The test findings for both Test I and Test II demonstrated an improvement in the ability to solve mathematical problems, as measured by the normalised gain index. The use of this E-Module, based on the PBL learning idea, has the potential to improve students' ability to solve mathematical issues. The normalised gain index indicated an increase in the students' mathematical appreciation elevation score in both the first and subsequent exams. Thus, it is logical to infer that the use of the PBL-based E-Module may improve students' mathematical appreciation.

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