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THE DEVELOPMENT OF MATHEMATICS LEARNING E-MODULES WITH THE PQ4R STRATEGY TO IMPROVE STUDENTS' CREATIVE THINKING ABILITIES AND LEARNING INDEPENDENCE

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Abstract

This expreimention directs to analyze: 1) the validity, practicability and effectiveness of e-modules with the PQ4R strategy developed to escalate students' creative thinking abilities and learning independence; 2) increasing students' creative thinking abilities through e-modules with the developed PQ4R strategy; 3) increasing students' learning independence through e-modules with the developed PQ4R strategy. This expreimention is development exploration operate the ADDIE development model. This development model be made up of 5 development phase, namely Analyze, Define, Development, Implementation and Evaluation. From the outcomes of attempt I and attempt II it was accured : 1) E-module with the PQ4R strategy which was arise to boost students' creative thinking abilities and learning independence, has met the belief of being valid, practical and effective; 2) Escalating the capability to think creatively using e-modules with the PQ4R strategy that has been arise as seen from the N-gain profit in attempt I of 0.36, escalating to 0.40 in attempt II, acceptation it is in the "medium" bracket; and 3) Escalating students' learning independence using e-modules with the PQ4R strategy that has been developed as seen from the N-gain value in attempt I of 0.21, increasing to 0.32 in attempt II, acceptation it is in the "medium" bracket. profit

Keywords: E-Module Development, ADDIE Model, PQ4R Strategy, Creative Thinking, Learning Independence

Abstrak

Pengkajian ini bermaksud untuk menganalisis: 1) validitas, kepraktisan dan efektifitas e-modul dengan strategi PQ4R yang diperluaskan berkenaan peningkatan kemampuan berpikir kreatif dan kemandirian melatih diri Anak ajar; 2) penaikkan kemampuan berpikir kreatif anak ajar melewati e-modul dengan strategi PQ4R yang dikembangkan; 3) peningkatan kemandirian belajar peserta didik melalui e-modul dengan strategi PQ4R yang diperluaskan. Penelaahan ini mengcorakkan penelaahan perluasan dengan memakai model pengembangan ADDIE. Model penelaahan ini termuat dari 5 babak pengembangan yaitu Analyze (Analisis), Define (Definisi), Development (Pengembangan), Implementation (Implementasi) dan Evaluation (Evaluasi). Dari dapatan uji coba I dan uji coba II digapai: 1) E-modul dengan strategi PQ4R yang diperluaskan terhadap peningkatan kemampuan berpikir kreatif dan kemandirian melatih diri anak ajar, sudah mengantongi taraf valid, praktis dan efektif; 2) Peningkatan kemampuan berpikir kreatif memakai e-modul dengan strategi PQ4R yang telah diperluaskan ditatap dari poin N-gain pada uji coba I berbilang 0,36 menaik membentuk 0,40 pada uji coba II, tafsirnya berkedudukan dalam taraf “sedang”; dan 3) Peningkatan kemandirian melatih diri anak ajar memakai e-modul dengan taktik PQ4R yang telah diperluasankan ditatap dari poin N-gain pada uji coba I berbilang 0,21 menaik membentuk 0,32 pada uji coba II, tafsirnya berkedudukan dalam taraf “sedang”.

Kata kunci: Pengembangan E-Modul, Model ADDIE, Strategi PQ4R, Berpikir Kreatif, Kemandirian Belajar

INTRODUCTION

Education is a very important part of everyday life. Through the educational process, humans understand many things. Education will help a person in living his life. Education can be obtained from formal or non-formal channels. Formal education is designed systematically and purposefully so that its achievements can be measured. One of the

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lessons learned in formal education is mathematics. Indonesian Minister of National Education Regulation point 23 of 2006 states that the Graduate Competency Standards (SKL) for Primary and Secondary Education Units state that mathematics subjects need to be given to all levels of education to equip students with the capability to expect rationally, analytically, regularly, critically and innovative, and the capability to collaborate.

Mathematical activities can equip students to be able to think and collaborate. The aim is for students not only to become consumers of knowledge but also to be able to produce new knowledge. According to Trianto (2011), mathematical activities are carried out through observation, formulating problems, formulating hypotheses and testing hypotheses through experimentation or proof, to drawing conclusions and discovering theories and concepts.

The activities designed should focus on learning objectives, namely being able to construct knowledge independently involving cognitive, affective and psychomotor processes. This is because every individual has creative potential, but the role of the learning environment is very important in being able to develop it. It is hoped that this learning environment can train innovative both implicitly and explicitly in learning.

Students as the nation's successors are the main object of education, whose soft skills or hard skills must be developed. Currently, students with the ability to think and be independent are one of the goals expected as the nation's successors. Students are prepared to be able to independently face various global problems and challenges in the future. Students must also equal to to think innovative to equal to solve problems in real life.

Basically, students have character which is divided into three aspects, namely affective, cognitive and psychomotor. This is in accordance with Bloom (1956) who said that every child experiences development from three aspects, namely the cognitive aspect, the affective aspect and the psychomotor aspect. Cognitive is related to mental activities in acquiring, processing, organizing and using knowledge. Affective is related to feelings or emotions, while psychomotor is physical activity related to mental processes. These three aspects really determine the quality of students.

One of the cognitive aspects that is very important and has been described from the start of this problem is the capability to think innovative. Considering that the capability to

think innovative is needed in everyday life, Alexander (2007) states that an individual's success in life is largely purposeful by their capability to creatively solve mess, both on a large and small escalade.

According to Harriman (2017), creative thought is thinking that tries to build fresh ideas. Creativity (creative thinking) is the capability to find various alternative answers to a solution. Every individual has the potential to produce creativity. This potential exists because every individual has the capability to think innovative. However, the capability to think innovative is not absolutely a trait inherited from parents. This capability to think creatively in a person can be grod and trained through the learning process. One of them is in learning mathematics.

The main actor in learning is the teacher. Teachers must understand their responsibility to educate students in developing hard skills and soft skills. Teachers also have a responsibility to be able to grow these abilities so that students are ready to face global challenges in real life. This means that teachers are needed who are able to manage learning well, develop learning innovatively, appropriate media, easy-to-use teaching materials or whatever is needed for better classroom learning.

In managing learning, teachers must use the most effective methods possible. Teachers must have creativity and innovation. Creative and innovative teachers are teachers who are able to create various efforts so that their students become creative individuals too. Teachers look for various learning strategies to repair their students' creative thinking abilities. However, in order for these efforts to be more optimal, teachers must understand the circumstances and characteristics of their students. With the abilities and skills possessed by teachers in the classroom and an understanding of their students, it will be easy for teachers to find effective methods if viewed from the abilities expected of students.

Therefore, it appears that the capability to think creative is useful and must be cultivated from the start. However, it cannot be denied that students' creative thinking abilities in Indonesia are relatively low. Stand on the explanation above, it appears that the capability to think creatively mathematically is very essential for students considering with this ability students will learn that there are many ways to solve a problem and there is more than one possible solution for one problem, students are trained to carry out

exploration, think comprehensively and reason logically and students can develop learning independence, and form social values through group work.

However, several research results reveal that learner creative mathematical thinking abilities are still far from expectations. The outcomes of Juitaning's research (2022) show that learner with creative thinking abilities have not been able to think creatively well, especially in the aspect of mathematics scores which are still low. According to Hasanah & Surya (2017) the factor that causes creative thinking not to arise during schooling is the curriculum which is generally calculated with broad substance targets, so that educators center more on completing the substance rather than teaching methods that can boost creative thinking abilities.

Construct on the sequel of observations made by investigator at SMP Dharma Pancasila Medan, it was found that learner creative thinking ability scores were in the low category. This is known from the results of diagnostic tests given by researchers using flat-sided geometric material. The researcher gave a test with the C4-C5 cognitive domain to see how students solved the problems given in the material on flat-sided spatial shapes based on indicators of creative thinking abilities according to(Munandar, 2014), namely Fluency (generating lots of ideas), Flexibility (generating answers varied), Elaboration (able to develop an idea), and Originality (able to give birth to new expressions).

The sequel of the investigator conference with Mrs. Simbolon, S.Pd as for mathematics teacher in class VIII SMP Dharma Pancasila Medan confirmed that students' mathematical creative thinking abilities, especially in flat-sided spatial figures, cannot be said to be classically good. He stated that "students' ability to solve problems on flat-sided geometric material each year is still far from what was expected, students are only able to solve them using one method, students are not yet able to carry out fluency, detail, flexibility and students are not equal to originalize the solutions carried out by students, This can be seen through students' answers. Several factors cause students to not be able to think creatively, because students do not study the material so students cannot get an idea of the material, students do not dare to ask the teacher, students also do not read actively where the student should equal to remember and even be conscious of the information provided, Learner also do not try to understand the information presented, students also do not recall the material presented. "It's not only experienced by class VIII this year, but the

same thing is also found in class VIII students every year." This indicates more specifically that the creative mathematical thinking abilities of students at Dharma Pancasila Middle School in Medan, especially in flat-sided geometric material, are still relatively low.

Apart from diagnostic tests, researchers also made observations during mathematics learning at Dharma Pancasila Medan, it was found that the teaching materials used during learning were only printed books which were usually distributed to students. Mathematics Student Book for Class VIII Revised Edition 2017 Ministry of Education and Culture of the Republic of Indonesia. In this book, not many of the problems presented are related to students' real lives. The problems given in the book do not help students to connect the material with students' experiences directly. In mathematics learning so far, teachers have never used other teaching materials such as digital-based teaching substance as student studying resources.

From the descriptions above, it can be concluded that students are not used to connecting mathematics learning with real world problems, this is due to students' lack of understanding in connecting the material with students' direct experiences. As a result, students are unable to solve problems using the methods they have learned in mathematics.

Student learning independence has different levels, independence is one of the pillars that influences student studying success. A student's independence can be seen from the habits they carry out, such as planning learning activities. Learning independence is very important because it influences the creation of self-motivation to learn. According to Thoha, (1993) Independent studying involves the ability to engage in critical, innovative, and innovative thinking. It requires not being easily swayed by the opinions of others, facing and addressing problems rather than avoiding or fleeing from them. Involves problem-solving through deep thought processes. But, necessitates not feeling inferior when being different from others. It requires working diligently and with discipline. And also involves taking responsibility for one's own actions.

One way that can overcome this gap is by innovating teaching materials. New innovations in teaching materials that you want to convey to students are the right steps to foster students' interest in learning. It is hoped that innovations in teaching materials carried out by educators can change students' paradigms in mathematics lessons which

seem difficult. This is the background for the author to develop a material, one of which is electronic-based. The teaching materials used by the author are electronic modules (E-Modules).

E-modules are modules in electronic form where access and use can be done via electronic devices such as computers, laptops, tablets or smartphones. E-modules are interactive media created using special e-book programs such as Flipbook Maker. Electronic modules can be defined as independent learning materials that are arranged systematically to support learning to achieve certain competencies which are presented in electronic format. It is hoped that the e-module being expand can make the studying process more interactive, through pictures and videos discussing questions, so that the subtance presented is easier to be conscious. Apart from that, it encourages students to analyze difficulty to discover, be conscious, and apply related mathematical concepts.

The advantage of the e-module developed in this research apart from electronic presentation is the application of the PQ4R strategy in preparing the material. In the studying operation, one of the innovative learning strategies that can develop learning independence is the Preview, Question, Read, Reflect, Recite, Review (PQ4R) plan. The PQ4R strategy is a series of steps taken in understanding reading. (in Trianto 2007) this is one part of the elaboration strategy which has steps in the sequence Preview, Question, Reflect, Recite, Review. In the studying stages, this strategy is suitable for developing learning independence. The content that will be included in this module is also expected to develop students' cognitive abilities such as creative thinking. The weakness of the e-module being developed is that there are inadequate learning tools for accessing the e-module

Based on the problem and possible solutions that can be used, the author continues the steps to develop relevant teaching materials, namely mathematics learning modules with the PQ4R strategy. Modules with the PQ4R strategy can be used by students independently without having to always involve the teacher. So the author believes that developing learning modules using the PQ4R strategy can be used to boost students' creative thinking capabilities and studying independence in a valid, practical and effective manner.

METHODS

Subjects in this inquiry are learner of the eighth phase at SMP Dharma Pancasila Medan in the school year 2023/2024. The object of this research is teaching subtance in the form of e-modules with the PQ4R strategy. To boost students' creative thinking abilities and learning independence. This phase of exprerimentation is exprerimentation and development. The exprerimentation and development carried out is to develop a new product and perfect it. The development model used as the basis for this exprerimentation is the ADDIE model. As the name suggests, this model be composed of five main period, that is to say : (A) analysis, (D) design, (D) development, (I) implementation, and (E) evaluation. By applying this model, investigator will expand a teaching subtance outcome in the form of an E-Module with the PQ4R strategy.

The practicability data analysis approach apply outcome obtained from the Likert Escalade. In this inquiry, 4 escalade were apply with the aim of abstain reaction 3, undecided, or agreeable which tend to be called by offender and checker. If it is in the valid bracket (2,50 ≤ V_a < 3,25), then the e-module is acceptable for testing in the field after making advancement if there are profitable suggestions from the validator.

Teacher and student acknowledgment in this exprerimentation are considered to meet the hands-on aspect if they have a student acknowledgment profit of R ≤ 2,50 (good or very good). The e-module being developed is said to be hands-on if the average learning implementation is at least in the 'Well accoutered' bracket (2,50 ≤ O_k < 3,25).

Table 1 Level of Creative Mathematical Thinking Ability

Value Interval	Category
81% skpk 100%	Very High
61% skpk 80%	High
41% skpk 60%	Medium
21% skpk 40%	Low
0% skpk 20%	Very Low

(Aisyah et al., 2018)

The average increase in learning independence test aims to have an effect on the average expand in students' learning independence after participating in learning using e-

modules with the PQ4R strategy. The average expand in students' studying independence can be calculated using percentage data analysis as quoted by (Suharsimi, 2006) below:

Note: P = Percentage.

n = Number of scores obtained.

N = Maximum number of scores.

S = Number of questions/aspects

Tabel 2 Categories of Student Learning Independence Level in Mathematics

Value Interval	Category
	Very High
	High
	Medium
	Low
	Very Low

(Hendrayana, Thaib, and Rosnenty, 2014)

RESULTS AND DISCUSSION

This research is development research, so the final outcome of this exploration is an electronic module based on the PQ4R strategy and contains flat-sided building material. The aim of this research is to analyze the following: (1) the validity of the e-module developed with the PQ4R learning strategy to improve creative thinking abilities and independent learning in Dharma Pancasila Middle School students in Medan; (2) the practicality of the e-module developed with the PQ4R learning strategy to improve creative thinking abilities and learning independence in Dharma Pancasila Middle School students in Medan; (3) the effectiveness of the e-module developed with the PQ4R learning strategy in improving creative thinking abilities and learning independence in Dharma Pancasila Middle School students in Medan; (4) increasing students' creative thinking abilities through e-modules developed with the PQ4R learning strategy; and (5) increasing student learning independence through e-modules developed with the PQ4R learning strategy. To achieve this goal, the ADDIE model was used in the development research carried out. The first point of this model is analysis, the second point is design, the third point is development, the fourth point is implementation, and the fifth and final point is assessment.

Trials I and II will reveal whether the problem formulation and research statements in the previous section have been addressed. The outcome of trials I and II show that (1) the e-

module based on the PQ4R strategy model is valid, (2) practical, (3) successful, (4) improves learner mathematical creative thinking abilities, and (5) improves learner mathematical creative thinking abilities . 'the joy of mathematics.

The validity of the E-Module is due to several factors: The PQ4R strategy-based E-Module has demonstrated its efficacy. Creation of E-Modules based on the PQ4R strategy according to the criteria. This curriculum requires students to master the basics and basic abilities in learning activities that are in accordance with the lesson content and PQ4R strategy paradigm. Arikunto (2012:203) states that a learning program is said to be valid if it can achieve certain goals by using the materials or instructions provided. The validity of these items is sometimes called curriculum validity. The E-Module based learning paradigm and PQ4R strategy have demonstrated structural validity. In developing the E-Module based on the PQ4R strategy, concepts and indicators of mathematical creative thinking and independent learning are combined with problem-based learning. The E-Module developed is designed to complement the RPP and E-Module which are adapted to the PQ4R strategy to measure students' creative thinking abilities and learning independence. Akbar (2013) added that validating developing learning programs is important.

CONCLUSION

The validity of the E-Module stand on the PQ4R strategy developed is in the valid bracket bracket. The research instruments include the Mathematics Creative Thinking Ability test and the Learning Independence Questionnaire (Pre-test and Post-test) which are included in the valid and reliable categories. The E-Module based on the PQ4R strategy developed has met the practicality criteria of the E-Module in terms of analysis of the results of observations of learning implementation. The E-Module based on the PQ4R strategy developed meets the effectiveness criteria stand on: (1) the achievement of students' creative mathematical thinking abilities, (2) the achievement of students' learning independence, and (3) students' responses to the E-Module. Increasing students' mathematical creative thinking abilities can be seen from each aspect of mathematical creative thinking abilities. Based on the normalized n-gain, it was found that in trials I and II there was an increase in the score of mathematical creative thinking abilities. So it can be draw to close that the E-Module based on the PQ4R strategy developed can improve

LEARNER mathematical creative thinking abilities. Increasing student learning independence can be seen from each aspect of learning independence. Stand on the normalized n-gain, it was found that in trial I and trial II there was an boost in students' Learning Independence questionnaire scores so it can be draw to close that the E-Module stand on the PQ4R strategy expand can increase students' Learning Independence

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