

Development of Problem Based Learning (PBL) teaching modules to improve mathematical creative thinking skills

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ABSTRACT

Students' mathematical creative thinking skills are still relatively low because the learning process does not fully encourage students to think critically and solve problems independently. This study aims to produce a Problem-Based Learning (PBL) teaching module to improve students' mathematical creative thinking skills in relations and functions. This type of research is research and development (R&D) using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The research instruments consisted of a validation sheet, a questionnaire for teachers and students, and a test of mathematical creative thinking skills. The results of the analysis of the teaching module validity obtained a score of 3.55, which is considered valid. For the practicality analysis results, the teacher response questionnaire obtained 95% in the very positive category, and the teaching module implementation obtained 2.00 with a fully implemented qualification. The results of the effectiveness analysis showed that 70.13% of student responses to the questionnaire were in the "good" category, with student activity at 72.33% (good) and an increase in mathematical creative thinking skills based on a comparison of pretest and posttest scores. Thus, this problem-based learning teaching module is valid, practical, and effective for use in the teaching and learning process and is capable of improving students' creative mathematical thinking skills.

Keywords: *teaching module, problem-based learning, mathematical creative thinking ability.*

1) INTRODUCTION

In this day and age, education plays a vital role because it is essentially a basic need for every human being. From birth, humans have no knowledge, but they are equipped with natural potential that can be developed through the process of education. Education is a process that is deliberately and systematically designed to create an environment and learning activities that encourage students to actively develop their potential. The goal is for them to have spiritual strength, self-control, mature personalities, intelligence, good character, and the skills needed for themselves, society, the nation, and the state (Siagian, 2016). The quality of education in Indonesia at the end of this period is very concerning. This situation occurs because there are a number of problems in the education system in Indonesia that have an impact on the low overall quality of education (Fitri, 2021). Every year, the

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education system in Indonesia continues to be reformed in order to improve its quality. These reforms aim to improve aspects that are not yet optimal in developing students who are intelligent, knowledgeable, and have good character (Ratnawati et al., 2020).

Learning is at the core of education, making it an important aspect for every individual. Mathematics is one of the important components of science. When viewed from the classification of scientific branches, mathematics belongs to the exact sciences, which emphasize creative thinking rather than mere memorization (Usman Aripin, 2017). In the context of mathematics, mathematics learning plays an important role in developing students' logical and analytical thinking skills. One of the aspects expected of students is creative thinking skills (Utam et al., 2020).

Creative thinking skills are classified as a form of higher-order thinking (HOT). This ability is very important and needed in various fields, one of which is mathematics (Faturrohman & Afriansyah, 2020). Mathematical creative thinking ability is the ability to develop new ideas, connect concepts, and solve mathematical problems either in conventional or innovative ways. Creative thinking skills in mathematics need to be developed from elementary school level and should be a major concern for educators, because students who have mathematical creativity will find it easier to face various learning challenges (Dalilan & Sofyan, 2022). These creative thinking skills are useful for solving problems and finding various alternatives and solutions to issues that arise in society.

The results of interviews and observations indicate that students' mathematical creative thinking skills are still relatively low. This is because students are only able to answer questions that correspond to the examples given by the teacher. Low mathematical creative thinking skills may be caused by teaching methods in schools that usually only encourage convergent thinking patterns and are limited to verbal and logical reasoning, without giving students room to explore or use creative approaches (Octaviyani et al., 2014). Learning media is an important component in the teaching and learning process that plays a vital role. Teachers use this media as a communication tool so that the material presented is easier for students to understand (Wulandari et al., 2023). Choosing the right learning media can help students understand learning materials more easily, interestingly, and interactively, thereby optimizing their abilities, because learning media is an important factor in the teaching and learning process (Wulandari et al., 2023). Choosing the right learning media can help students understand learning materials more easily, interestingly, and interactively, thereby optimizing their

abilities, because learning media is an important factor in the teaching and learning process (Wulandari et al., 2023).

Based on the description of the problems found, the solution offered in this study is the development of a problem-based learning (PBL) teaching module to improve the mathematical creative thinking skills of eighth-grade students in the subject of relations and functions. This teaching module is designed to be valid, practical, and effective in accordance with the current curriculum (Merdeka curriculum).

2) METHODS

This study applied a research and development (R&D) method using the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The purpose of this study was to develop a Problem-Based Learning (PBL) teaching module to improve the mathematical creative thinking skills of eighth-grade students in the subject of relations and functions. The analysis stage involves performance analysis and needs analysis. Performance analysis aims to identify and clarify problems experienced by students, while needs analysis aims to determine what students need to learn. In this case, the analysis will identify learning objectives, the curriculum used, and what is expected of students. The design stage involves designing problem-based learning teaching modules, starting from the cover, formulating learning objectives, learning materials, to compiling the learning activity process. The development stage covers the process of creating problem-based learning teaching modules that have been designed in the previous stage, after which validation tests and revisions will be carried out based on suggestions and input from validators. The implementation stage is where the developed teaching modules are tested by teachers and students in a real classroom learning environment, and the previously developed research instruments are distributed. The final stage is the evaluation stage, where the developed teaching modules are assessed and reviewed to determine whether they are suitable for use in the teaching and learning process.

The subjects of this study were 27 students in class VIII.C at SMPN 2 Jeneponto. The instruments used in this study were validity instruments in the form of validity sheets, practicality instruments in the form of (1) teacher response questionnaires; (2) and learning implementation analysis sheets, and effectiveness instruments in the form of (1) student response questionnaires; (2) student activity

sheets; and (3) tests of students' mathematical creative thinking abilities. The data collection methods used in this study were interviews, questionnaires, and tests of mathematical creative thinking skills.

The data analysis used in this study is validity data analysis by calculating the average and then categorizing it based on the following table:

Table 1: Validation Criteria

Interval	Category
$M < 1.5$	Not Valid
$1.5 \leq M < 2.5$	Less Valid
$2.5 \leq M < 3.5$	Valid
$3.5 \leq M \leq 4$	Very Valid

For the analysis of the practicality of the teacher response questionnaire and the implementation of the module, the data was analyzed by calculating the average and then categorizing it based on the following table:

Table 2: Criteria for teacher response questionnaires

Score Range	Criteria
$RS < 50\%$	Not Positive
$50\% \leq RS < 60\%$	Less Positive
$60\% \leq RS < 70\%$	Quite Positive
$70\% \leq RS < 85\%$	Positive
$85\% \leq RS < 100\%$	Very Positive

Table 3: Criteria for the degree of feasibility

Interval	Category
$1.5 \leq M < 2$	Fully Implemented
$0.5 \leq M < 1.5$	Partially Implemented
$0 \leq M < 0.5$	Not Implemented

To analyze the effectiveness of the student response questionnaire and student activities, the data was calculated using averages and then categorized based on the following table:

Table 4: Criteria for student response

Score Range	Criteria
$RS < 50\%$	Not Positive
$50\% \leq RS < 60\%$	Less Positive
$60\% \leq RS < 70\%$	Quite Positive

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$70\% \leq RS < 85\%$	Positive
$85\% \leq RS < 100\%$	Very Positive

Table 5: *Criteria for student activities*

Percentage	Qualification
$80\% \leq P < 100\%$	Very Good
$60\% \leq P < 80\%$	Good
$40\% \leq P < 60\%$	Enough
$20\% \leq P < 40\%$	Less
$0\% \leq P < 20\%$	Very Less

3) RESULTS AND DISCUSSION

This study produced a problem-based learning teaching module on relations and functions with the aim of improving students' mathematical creative thinking skills and ensuring that the teaching module is valid, practical, and effective. This study began with an analysis phase, which involved analyzing the basic abilities of students, the curriculum used, and the teaching and learning process in the classroom. The results of the analysis showed that the problems identified were a lack of understanding among students in answering questions asked by teachers, and that students were only able to answer questions that were similar to those explained by teachers. Meanwhile, the results of the curriculum analysis showed that the independent curriculum was used.

At the design stage, the results of the analysis stage are used as the basis for producing the initial design of the teaching module being developed. In this design stage, several aspects are carried out, such as selecting the teaching module format and designing an initial colorful teaching module that is neatly structured so that students are interested in reading it. In addition to selecting the teaching module format, instruments to be used in this study will also be prepared, such as teacher response questionnaires, student response questionnaires, and tests of students' mathematical creative thinking abilities.

During the development stage, the teaching module design from the previous stage is implemented. This stage begins with the implementation of the concept developed during the design stage. After the teaching module has been implemented, it must undergo a validation stage. This validation stage is carried out by validators and is then revised based on the validators' criticism and suggestions. In addition to the teaching modules, the instruments that were created earlier will also

undergo a validation stage before being used in the research process. The teaching modules and instruments produced are validated by two validators consisting of mathematics education lecturers. The results of the validation by the validators regarding the teaching modules and instruments developed are shown in Table 6 below.

Table 6: *Teaching module validation results*

Aspect	Evaluation	Information
Content Aspect	3,63	Very Valid
Presentation Aspect	3,58	Very Valid
Language Aspects	3,33	Valid
Graphic Aspects	3,66	Very Valid
Average	3,55	Sangat Valid

Based on Table 6, it can be concluded that the teaching module developed has been validated by the validators based on the four aspects of assessment, namely content, presentation, language, and graphics. Overall, the teaching module received an average score of 3.55, indicating that it falls into the “Highly Valid” category according to the validation criteria used. This validity result shows that the content of the teaching module is in line with the curriculum and the needs of the students, the presentation of the material is well-structured, and it is appropriate for the developmental level of the students. After the validation process, the developed teaching module is ready for implementation.

The implementation stage, after the teaching module has been declared valid based on the assessment of the validators, is followed by the implementation of the teaching module in a real classroom situation. The results of this implementation will be used as a reference in revising the teaching module. This trial was conducted by 27 eighth-grade students. In implementing the use of the teaching module, the students were divided into several groups so that they could complete the LKPD in groups. At this trial stage, instruments regarding the developed teaching module will also be distributed to students and teachers.

At the evaluation stage, the teaching modules that have been used will be evaluated based on the results of the analysis of the instruments provided by the researchers to be filled out by students and teachers. This stage will evaluate the practicality and effectiveness of the teaching modules developed.

To assess the practicality of the teaching module, we can look at (1) the teacher response questionnaire; and (2) the learning implementation sheet. From the analysis of teacher responses to

the teaching module developed, we obtained an average percentage of 95%. Meanwhile, the learning implementation can be seen in Table 7.

Table 7: *Results of module implementation analysis*

Meeting	Aspect A	Aspect B	Category
Meeting Ke-I	2,00	2,00	Fully Implemented
Meeting Ke-II	2,00	2,00	Fully Implemented
Meeting Ke-III	2,00	2,00	Fully Implemented
Meeting Ke-IV	2,00	2,00	Fully Implemented
Average			2,00

In Table 7, the analysis of the teaching module implementation was conducted at each meeting. Based on the results of the module implementation analysis, the teaching module was conducted during four meetings. At the first meeting, the teaching module implementation was fully implemented. At the second meeting, the teaching module implementation was in the fully implemented category. At the third and fourth meetings, the teaching module was also in the fully implemented category. Therefore, it can be concluded that based on the results of the analysis of the implementation of the module during four meetings, the average result was 2.00, which indicates that this result is in the fully implemented category.

The effectiveness of the teaching module was assessed based on (1) student response questionnaires; (2) student activity sheets; and (3) the results of tests of students' mathematical creative thinking abilities. Analysis of the student response questionnaires to the teaching module yielded a score of 70.13%, which falls into the positive category. The results of the analysis of the student activity sheets can be seen in Table 8 below.

Table 8: *Results of student activity analysis*

Meeting	Percentage	Information
Meeting ke-I	80.7%	Very Good
Meeting ke-II	58,14%	Enough
Meeting ke-III	80%	Good
Meeting ke-IV	70,5%	Good
Avarage	72,33%	Good

Table 8 shows the results of the analysis of student activity. The analysis of student activity was conducted at each meeting using the teaching module. The table above shows that in the first meeting,

student activity was at 80.7%, in the second meeting it was at 58.14%, in the third meeting it was at 80%, and in the fourth meeting it was at 70.5%. Based on the above analysis results, student activity was at an average of 72.33%, which is in the good category.

The analysis of students' mathematical creative thinking skills showed an improvement in their mathematical creative thinking abilities. This was demonstrated by the improvement in students' test results before and after using this problem-based learning teaching module.

4) CONCLUSIONS

The results of this study indicate that the problem-based learning teaching module that has been developed meets the criteria of validity, practicality, and effectiveness. The validation results obtained an average of 3.55, which is categorized as highly valid. The practicality results were seen from (1) the teacher response questionnaire, which obtained an average percentage score of 95%; and (2) the learning implementation sheet, which obtained an average of 2.00, which is categorized as fully implemented. The effectiveness results were assessed based on (1) student response questionnaires, which obtained a score of 70.13% in the positive category; (2) student activity observation sheets, which obtained an average percentage of 72.33% in the good category; and (3) the results of students' mathematical creative thinking ability tests, which showed an increase from the pretest to the post test results. Therefore, it can be concluded that this problem-based learning teaching module is not only valid, practical, and effective, but it can also improve students' mathematical creative thinking skills.

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