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Probing-Prompting Learning with Product Assessment to Improve Student Mathematics Learning Outcomes

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ABSTRACT
This study aims to: (1) describe the implementation of probing-prompting learning with product assessment; and (2) testing the effectiveness of probing-prompting learning with product assessments to improve student learning outcomes. Subjects in the study amounted to 35 students. This research uses an ex post facto approach. Data on learning outcomes were collected by testing and analyzed using one sample t-test and gain test, while qualitative analysis was carried out by describing the implementation of probing-prompting learning with product assessment. The results showed that (1) the application of probing-prompting learning with product assessment in mathematics learning was carried out using the concept discovery, inductive methods, discussion learning techniques, question and answer, and product assessment; and (2) probing-prompting learning with effective product assessment to improve student learning outcomes.

Keywords: *mathematics learning outcomes, probing-prompting, product assessment*

1. INTRODUCTION

In the era of globalization which is marked by the advances in information technology today, it must be balanced with a high-quality education. Schools need to synergize with teachers to implement 21st-century curriculum and learning to prepare students to be able to face the challenges of today's complex era [1]. Facing this condition, the teacher always strives to improve learning both in mastery of the material and learning methods. To improve the quality of mathematics learning that aims to achieve optimal learning outcomes is not an easy thing. This is because the learning process that occurs is not directed at generating the student's own learning experience.

Mathematics learning which is generally applied by teachers is conventional by using expository learning [2]. In this learning, the teacher dominates the teaching and learning process and becomes the center of learning activities. In learning, the teacher only conveys the material and writes questions on the blackboard, students listen to the teacher's explanation, then some students are asked to solve problems in front of the class [3]. Learning in the classroom with the pattern of delivering material still makes mathematics an abstract thing, something that still feels difficult to learn. Mathematics learning should be directed to provide understanding to students about mathematics subjects by constructing students' knowledge [4], [5].

Geometry is one of the materials considered difficult by students [6], [7], because one of the characteristics of mathematics is that it consists of a series of abstract concepts. One of the efforts to overcome students' difficulties in learning something abstract is to use visual aids [8], [9]. This is to bridge students in learning abstract mathematical concepts into reality through manipulative geometric models. The use of teaching aids can also help students in instilling concepts so that they are easier to understand.

MTs. NU Nurussalam is a one of junior high school in Kudus, Central Java. Based on the results of interviews with several Mathematics teachers at the school, information was obtained that geometry is a part of Mathematics material which is considered difficult for students to understand. The explanation from the teacher was strengthened by data on the daily test scores

for students' circumference and area of the circle. The results of the test showed that as many as 80% of students did not meet the Minimum Completeness Criteria. The difficulties faced by students are caused by several things, including students who do not understand the elements of these shapes, problems with arithmetic operations on flat figures, and because of the many and complex formulas that students must understand. This perception arises because students are not directly involved in finding formulas, lack of learning media, and lack of student interest in learning.

Based on the problems that occur in the field, it is necessary to do innovative learning. In learning mathematics, learning is carried out through an approach that can provide opportunities for students to find a concept of a mathematical formula. Students are facilitated to construct their own knowledge so that their knowledge will stay longer in their minds. The teachers encourages students to continue to construct their knowledge and facilitate activities in learning that are useful for students to gain understanding [10]. Constructivist learning activities are carried out in the form of group work. One of the learnings that take shelter in constructivism theory is cooperative learning. Cooperative learning is a learning strategy used to increase collaboration between students in groups so that students will feel more comfortable when communicating between peers compared to teachers [11], [12]. Learning becomes more in-depth and has proven to be successful in increasing students' learning motivation [12], [13].

One approach in cooperative learning is probing-prompting. Probing-prompting is learning in which the teacher presents a series of questions that are guiding and exploring so that a thought process occurs that links the knowledge of students' attitudes and experiences with the new knowledge learned [14]. Furthermore, students construct concepts, principles, and rules into new knowledge [15]. Probing-prompting learning is closely related to a series of investigative questions [16], [17]. Based on the results of previous studies, probing-prompting learning can improve students' cognitive and affective abilities [18], [19].

In addition to the use of learning models, the assessment of students also needs to be considered, because one of the important aspects in the learning process is the assessment aspect [20]. One type of assessment is authentic assessment. Authentic assessment is described as an assessment of the facts of student development seen from different sides and competencies, which include students' methods, skills, and knowledge [21]. One of the authentic assessments that can be used in learning mathematics is product assessment. Product assessment is the assessment of students in controlling the process and utilizing/using materials to produce something, practical work, or the aesthetic quality of something they produce [22]. The results showed that learning mathematics with product assessment can improve students' mathematical abilities [23], [24].

Based on the results of existing research, there are several limitations of the study, including a series of probing-prompting questions given to students verbally through question and answer. In addition, existing product assessments are not integrated into probing-prompting learning. Based on existing problems and the results of existing research, it is necessary to apply mathematics learning using probing-prompting with product assessment. In this study, probing-prompting questions are given to students through worksheets and verbal reinforcement will be given. The worksheet contains product assessments that students must work on in groups as well as contains questions that encourage students to find the concepts of circumference and area of a circle.

Probing-prompting learning with product assessment is chosen so that learning becomes meaningful so students can construct concepts, principles, and rules into new knowledge independently so the knowledge formed will stay longer in their memory. In addition, product assessment is a class-based assessment of students' mastery of skills in making a product (process) and an assessment of the quality of student work (product). The product that will be produced by students can foster student creativity so as to achieve maximum learning outcomes. Besides, product assessment in this study is to attract interest in learning and make students enthusiastic about the material provided. Based on the description above, this study aims to: (1) describe the implementation of probing-prompting learning with product assessment; and (2) testing the effectiveness of probing-prompting learning with product assessment to improve student learning outcomes.

2. METHOD

This research uses an ex post facto approach. The population in this study were students of class VIII MTs. NU Nurussalam. The subjects in this study were students of class VII A, totaling 35 students. Quantitative methods were used to obtain data on the effectiveness of learning with a one-group pretest-posttest design. Data collection is done by using a test technique to get data on learning outcomes. Data were analyzed using one-sample t-test and gain test, then probing-prompting learning with product assessment was described qualitatively. Implementation of probing prompting learning with product assessment through the following steps: (1) initial activities, (2) core activities,

and (3) final activity. In the initial activity, the teacher recognizes the prerequisite knowledge possessed by students by using the probing technique. It serves for introduction, revision, and motivation. In the core activity, the learning process uses a probing-prompting technique accompanied by a product assessment, starting with the teacher guiding students to form groups. Then the teacher gives a product assessment that must be done by each group. The activities of students in making products are observed by the teacher and then analyzed and assessed using a scoring rubric. Furthermore, in the final activity, students show and explain the results of group products, make a summary as a conclusion of the teaching and learning process, and students are given a quiz to find out success in learning after doing this activity.

3. RESULT AND DISCUSSION

3.1 Implementation of Probing-Prompting Learning with Product Assessment in Mathematics Learning

Probing-prompting cooperative learning model learning with the application of product assessment is applied to class VIII-A. The learning implementation for the experimental class consists of five stages, namely (1) presenting problems, (2) asking questions according to indicators, (3) appointing a student to answer questions, (4) ask questions according to indicators with probing or prompting questions, and (5) ask final questions to test indicators. The five stages are adapted to the main activities in probing-prompting type cooperative learning and are used as the basis for implementing learning. This probing-prompting learning model is expected to be able to overcome problems and explore students' ideas so that students are able to express new knowledge and experiences in learning mathematics. [25].

Product assessment is an assessment of the process of making product quality made by students. Product assessment in this study has assessment criteria which include preparation, manufacturing process, and product results. This is in accordance with the product assessment conducted by Yustiana and Kusumadewi which includes: (1) the preparation stage which assesses students' skills to plan, find out and develop ideas, select and design products; (2) the production stage which assesses students' skills in selecting and using materials, tools, and techniques; and (3) product appraisal [22].

The implementation of learning begins with a questions and answer session to remind students of the prerequisite knowledge. Furthermore, students are guided by the teacher to form groups and then the teacher distributes Student Worksheets and product assessments for each group. At the first meeting, students worked on product assessments with the help of Student Worksheets. The product task at the first meeting was a circle prop to find the value of phi (π) and the formula for the circumference of a circle. In making this product, students design a circle model and then use the circle model by measuring the circumference of the circle with a tape and a ruler. After the students get data about the circle model, each group writes down the measurement data on the Student Worksheet and cardboard. The product assessments presented on cardboard will be used by the group for presentations at the end of the lesson. At the next meeting, the learning steps are the same as in the first meeting, but at this meeting, students get a product assessment to make a circle prop to find the formula for the area of a circle with a rectangular approach.

At the time of implementing probing-prompting learning with product assessment, students are required to be active in product-making group work because all process activities carried out by each group are monitored and assessed by the teacher using an assessment rubric. This makes all students enthusiastic and happy to be creative in making products.

Product assessment is one part of the class assessment. Class assessment is a process that aims to collect, synthesize, and interpret information in making decisions in the classroom [26]. Class assessment is often applied in Indonesia because it is in accordance with the current curriculum, especially with regard to aspects that are the main goals of education [27]. Product assessment is also part of authentic assessment. Authentic assessment includes a variety of techniques such as product, portfolio, checklist, observation, and project appraisal [28]–[30]. Authentic assessment takes place in the context of authentic activities with complex challenges, and is centered on active learners who produce products, and is associated with several learning indicators [31].

3.2 The Effectiveness of Probing-Prompting Learning with Product Assessment To Improve Student Learning Outcomes

After probing-prompting learning accompanied by product assessment is carried out, students are given tests to obtain data on learning outcomes which are then analyzed to determine the effectiveness of their learning. The description of the learning outcomes of students' circumference and area of circles after learning can be seen in Table 1.

Table 1 shows that student learning outcomes after probing-prompting learning accompanied by product assessments were better than before the learning was

carried out. It is shown that the average pretest and posttest results of students have increased from 51.49 to 79.91. In addition, the percentage of students who completed their studies increased from 20% to 94%.

Table 1. Description of student learning results

No	Descriptive Analysis	Pretest	Post-test
1	Number of students	35	35
2	The highest score	76	100
3	Lowest value	31	53
4	Average	51.49	79.91
5	Varians	173.43	105.19
6	Standard deviation	13.17	10.26
7	Percentage of learning completeness	20%	94%

The effectiveness of probing-prompting learning with product assessment to improve student learning outcomes in this study was based on the results of the learning mastery test and the normalized gain test. Before the mastery learning test was carried out, the posttest data were tested for normality. This is done as a prerequisite test to test the learning mastery hypothesis. Normality analysis in this study used the Kolmogorov-Smirnov with the help of the SPSS program. The results of the analysis using SPSS show that the significant value in the Asymp column. Sig (2-tailed) is 0.544 which means more than the 0.05 level of significance. It is concluded that the data comes from a normally distributed population.

The mastery test of individual learning was carried out by using one group sample t-test analysis of one tail. The proposed hypothesis is $H_0 : \mu \leq 65$, while for H_1: $\mu > 65$. The test criteria used are rejecting H_0 if $t_{count} \geq t_{table}$. The value of t_{table} is obtained from the list of distribution tables t with and dk = n – 1 = 35 – 1 = 34 and $\alpha = 5\%$, so the value of t_{table} used is 1.69. From the calculation results obtained that $t_{count} = 8.60$. This shows that $t_{count} \geq t_{table}$ so that there is a rejection of H_0 which means that students who are taught by probing-prompting learning accompanied by product assessments have achieved individual mastery of learning.

The classical learning mastery test can be analyzed using the one-party proportion test. The proposed hypothesis is H_0: $\pi \leq 0.75$ and H_1: $\pi > 0.75$. The test criteria, namely H_0 is rejected if $z_{count} \geq z_{table}$. The z_{table} value is obtained from the z distribution table list with 5%, which is 1.64. Based on the calculation results, it is found that the value of $z_{count} = 2.63$ so that H_0 is rejected. This means that students who learn through probing-prompting learning accompanied by product assessments achieve classical mastery learning.

The student learning outcomes data were then analyzed using the normalized gain test to determine the increase in learning outcomes before and after learning. The increase in learning outcomes is determined. The classical increase in students' mathematical communication skills is shown in Table 2.

Table 2. Increasing student learning outcomes

Criteria	Number of students	Percentage
High	9	25.71%
Medium	24	68.7%
Low	1	2.86%
Drop	1	2.86%

Table 2 shows that the highest increase of students is in the medium category, which is 68.57%. In the high improvement category it reached 25.71% of all students, while in the low increase category it was only achieved by one student or 2.86%. There is also a decrease in student learning outcomes, amounting to 2.86% of students.

In the calculation of the increase in student learning outcomes classically, the increase value is 0.58 or 58%. It can be concluded that the average increase in students' mathematics learning outcomes classically is in the medium category.

In carrying out the research, several obstacles were encountered, including: (1) it was difficult to plan the exact time required for each activity; and (2) it is difficult to avoid simultaneous answers from students. This is overcome by better preparing the learning that is done. When planning learning, teachers should arrange detailed time divisions, especially when students are working on product assessments. In addition, the questions that will be asked and the students who will be appointed need to be planned before learning. The activities of students while working on product assessments are monitored by the teacher and directed so that the discussion runs smoothly. To avoid simultaneous answers from students, the teacher can raise the questions to a higher level.

Despite the constraints, this research has several advantages in implementing probing-prompting learning accompanied by product assessment. The advantages of this learning include: (1) the teacher does not need to provide explanations, but rather invites students to find concepts independently through discussion and question and answer; (2) directed questions (prompting questions) posed by the teacher can guide students to the concepts being studied; (3) students' attention to the material being studied tends to be more awake because students always prepare answers; and (4) product creation through product assessment makes students

enthusiastic and more interested in learning mathematics.

Probing-prompting learning accompanied by product assessment makes learning meaningful. This can be used to overcome learning problems that have occurred so far, namely learning is dominated by teachers [32]. In research on the effectiveness of the probing-prompting type of cooperative learning model, it was concluded that the learning could increase the students' average math activity and learning outcomes [33]. Product assessment is one of the authentic assessments because the main principle is to strengthen the process and results [34]. Based on the results of the study, it was concluded that authentic assessment can improve students' cognitive skills [35]. Product assessment that is integrated into learning is proven to improve students' mathematical abilities [16], [23]. From the results of previous studies, it can be concluded that probing-prompting cooperative learning accompanied by product assessment is effective in improving student learning outcomes.

4. CONCLUSION

Based on the results of the research and discussion, it can be concluded that: (1) the implementation of probing-prompting learning with product assessment in mathematics learning is carried out by concept discovery, inductive methods, discussion learning techniques, questions and answers, and product assessment; and (2) probing-prompting learning with effective product assessment to improve student learning outcomes.

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