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PROBING-PROMPTING LEARNING: ITS EFFECT ON IMPROVING CONCEPTUAL UNDERSTANDING IN MATHEMATICS

Ulfa Najiya Hanifa[1], Suhendra Suhendra[2], Muhammad Fakhri Jauhari[3]

[1]Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No.229, Bandung, Indonesia.
ulfanajiya@upi.edu
[2]Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No.229, Bandung, Indonesia.
suhendra@upi.edu
[3]Institut Pertanian Bogor, Jl. Raya Dramaga, Bogor, Indonesia
fachrijrm@apps.ipb.ac.id

ABSTRACT

Understanding mathematical concepts plays a crucial role in students achieving favorable learning outcomes. However, there remains room for improvement in students' grasp of these concepts. The main objective of this research was to assess how effective the probing prompting learning model is in improving students' understanding of mathematical concepts. This research employed the quantitative approach with the experimental method. Used tests, observations, and questionnaires to collect the data. The study included 25 students in the experimental group and 26 students in the control group. The findings showed: 1) The average percentage of teacher activity was 96.30% ("very good" category); 2) The t-test analysis findings showed a significant difference in the enhancement of understanding of mathematical concepts between students exposed to the probing prompting learning model (high category) and those using conventional learning approach; 3) Students responded positively to the probing prompting learning model, as evidenced by their attitude. In conclusion, this study suggests that the probing prompting learning model can serve as an effective alternative for facilitating learning and improving students' understanding of mathematical concepts.

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Corresponding Author

Ulfa Najiya Hanifa
Universitas Pendidikan Indonesia
Jl. Dr. Setiabudi No. 229
Email: ulfanajiya@upi.edu

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INTRODUCTION

Concept understanding is crucial for students to achieve good learning outcomes, including in learning mathematics (Agustina, 2016). As Zevika et al. (2012) stated, concept understanding refers to the proficiency demonstrated by students in comprehending mathematical concepts and executing procedures (algorithms) with flexibility, accuracy, efficiency, and precision. The significance of grasping concept-understanding skills in mathematics is that mathematics explores a network of interconnected and mutually sustainable concepts (Novena & Kriswandani, 2018). Mastery of prerequisite material indicates a student's readiness to progress to the next lesson in mathematics (Nursalam et al., 2014). To master mathematical subject matter effectively, students must understand the previous concepts that serve as prerequisites for what has been learned and those that have not yet been covered (Yulia & Utami, 2018). Understanding concepts in mathematics learning also plays an essential role in achieving other mathematics learning objectives (Yusup, 2019).

Presently, the reality remains that there is room for improvement in students' capacity to grasp mathematical concepts (Novitasari, 2018). The lack of proficiency in grasping mathematical concepts stems from students who merely rely on memorization, leading to temporary retention of these concepts (Istorun, 2014). This deficiency in understanding is further supported by an interview with a math teacher from a junior high school in Bandung City, West Java Province, who said that students need to identify the information provided. This results in students needing to understand the problem contained in the problem, and students still need to demonstrate the correct application of the formula. A few of them still necessitate correction regarding the use of the formula. Based on the results of interviews with teachers, Year 9 students have a comparatively low level of proficiency in understanding mathematical concepts.

After interviewing the teacher and considering the supporting research highlighting students' poor grasp of mathematical concepts, it becomes evident that a learning model is required to enhance their understanding in this area. Piaget stated that mathematical understanding can be improved through learning models by students' cognitive development (Muna & Afriansyah, 2018). The probing prompting model is regarded as a learning approach that can enhance students' grasp of mathematical concepts (Swasono et al., 2014).

The probing prompting model is an instructional approach designed to foster students' proficiency in comprehending mathematical concepts. It achieves this by presenting guiding questions and encouraging students to explore and develop their understanding (Kartika, 2018). Consequently, this model facilitates a cognitive process, establishing connections between students' pre-existing knowledge and experiences and the newly acquired knowledge. (Danaryanti & Tanaffasa, 2016). By applying the probing prompting model, students are encouraged to participate in critical thinking while actively addressing the presented problems. This approach ensures that students are consistently guided to prepare for a series of problems that the teacher will ask them (Utami, 2016). One of the stages in the probing prompting model is probing questions (Agustina, 2016). At the probing question stage, the teacher invites students to remember and explore the understanding of the material, both those that have been learned and those that will be learned (Hartinah et al., 2019)ze. The aspect that requires enhancement is the students' comprehension of mathematical concepts, as it directly influences the depth of their understanding of these concepts (Mustika & Buana, 2017).

Understanding mathematical concepts can affect student learning outcomes (Diana et al., 2020). Another factor affecting student learning outcomes is internal factors. Both internal and external factors can influence students' academic achievements. Internal factors arise from elements within the learning individual, while external factors stem from the family, school, and community factors (Baharrudin, 2015). The internal factor is the student's response to learning in preparation, interest in learning, and attitudes towards learning (Aida et al., 2017). Therefore, researchers conducted an attitude scale test to determine these internal factors (Hutagalung, 2017). Through this test, teachers can determine students' responses or attitudes toward learning with the probing prompting model (Afrianti & Marlina, 2020).

The results of the interview analysis lack information provided by teachers regarding mathematical comprehension skills, even though students can understand procedures (algorithms) flexibly, accurately, efficiently, and precisely. Teachers were not aware of the benefits of using the probing prompting model on mathematical understanding abilities, one of which is increasing mathematics learning for students to think actively. There has been no effort to create learning using probing prompting models to improve mathematical comprehension skills. Hence, this study aims to compare the effectiveness of probing

prompting and the conventional model in enhancing the understanding of mathematical concepts of junior high school students in one of the cities in Bandung, West Java Province.

METHOD

This research employed a quantitative approach. This research utilizes a quasi-experimental approach, employing the Non-equivalent Pretest-Posttest Control Group Design as its research design (Sugiyono, 2015). The experimental group in this study was a class whose learning applied the probing prompting model, and the control group was a class applying the conventional model. The stages carried out in this study consisted of (1) pretest, (2) treatment, (3) posttest, and (4) concluding (Hartinah et al., 2019).

The participants in this study were Year 9 students from a junior high school in Bandung City, West Java Province, who experienced problems based on findings in the field. Group A (25 students) was the control group, and Group B (26 students) was the experimental group.

The research instruments used were tests of students' mathematical concept understanding ability, observation sheets, and student questionnaires. Data for this research was gathered through various instruments, including test instruments, questionnaires, and observations. The research employed specific tools to collect the data: (1) A test assessed students' understanding of mathematical concepts, measuring their achievement in essential competencies; (2) Using the probing prompting learning model, a questionnaire was employed to gauge students' responses to mathematics learning; (3) Additionally, observation sheets were utilized to evaluate the successful implementation of applied mathematics learning, gathering data to validate the effectiveness of the learning process.

The study's indicators for measuring mathematical concept understanding consist of the following: (1) the ability to restate concepts, (2) the ability to state concepts algorithmically, and (3) the ability to establish connections between various mathematical concepts. Data analysis techniques consisted of research instrument tests (validity, reliability, difficulty, and differentiation tests). The quantitative data analysis in this research involved a normality test, homogeneity test, similarity or difference test of two means, and hypothesis testing (Paired Sample t-test).

Based on the objectives of the study above, the following are the hypotheses:

H_0:$\mu_1 = \mu_2$: There is no difference in the ability to understand mathematical concepts of students who obtain probing prompting learning models with those who obtain conventional learning.

H_1:$\mu_1 \neq \mu_2$: There are differences in the ability to understand mathematical concepts of students who obtain probing prompting learning models with those who obtain conventional learning.

Microsoft Excel and SPSS programs were utilized to analyze all research instruments. Data for this study were collected through administering a pretest, posttest, and N-gain mathematical critical thinking ability test to evaluate the percentage of teacher activity implementation. Table 1 presents the criteria for implementation as proposed by Febriana (2021).

Table 1. Criteria for Percentage of Implementation

Activity Percentage	Interpretation
86% - 100%	Very Good
76% - 85%	Good
60% - 75%	Average
59% - 35%	Poor
0% - 34%	Very Poor

RESULT AND DISCUSSION

After implementing learning with the probing prompting model in Year 9, the results showed increased student learning outcomes on essential competencies related to opportunity material. Teachers implement the probing prompting learning model throughout the learning process, engaging students from the beginning to the end. The following are the steps of teacher activity in learning with the probing prompting model:

1) The teacher exposes students to new situations by showing pictures. At this stage, the teacher provides a picture of coins with two sections, namely head and tail, to be identified by students using the concept of probability. After the teacher gives the picture of the coins, students are expected to demonstrate their ability to use visual representations to articulate concepts associated with events, sample space, and sample points.
2) The teacher creates opportunities for students to formulate answers and engage in small discussions to help them develop their responses. During this stage, the teacher oversees the discussion process students initiate as they formulate answers to the questions posed by the teacher.

3) The teacher asks students additional questions aligned with all learning objectives or indicators. One of the teacher's questions was about the probability of rolling a sum of 9 when throwing 2 dice simultaneously. This question is part of the probing questions, thus involving the probing step. During this probing question stage, the teacher poses questions to encourage students to read and prepare the material before the lesson begins, ensuring they are ready to receive subsequent material.
4) The teacher selects students to answer the questions randomly. All students are expected to prepare to answer the following questions at this stage.
5) The teacher asks other students for feedback if they are correct about the answer. However, if the student has difficulty answering, the teacher poses further questions with clues leading to the desired solution. These types of questions are known as prompting questions.
6) At this stage, the teacher proceeds to ask students additional questions aligned with all students' learning objectives or indicators.

This research presents the results of teacher activities, differences in the improvement of students' mathematical concept understanding between those who receive probing prompting model learning and those who do not, and student attitudes. The analysis outcomes regarding the implementation of teacher activities during the learning process using the probing prompting learning model are presented in Table 2.

Table 2. Results of the Implementation of the Probing Prompting Learning Model

Learning Activities	Percentage (%)
First Meeting	88.89
Second Meeting	100
Third Meeting	100
Fourth Meeting	96.30

Table 2 indicates that the percentage of teacher activity achievement in the first meeting is 88.89%. In the initial meeting, the last step of the probing prompting learning model, which provides opportunities for students to review the material, had not been executed. This occurred due to the teacher's inadequate time management, leading to the conclusion of the learning session before all the steps could be completed. However, in the second and third meetings, the teacher successfully implemented all the learning model steps, achieving 100%. The average percentage of implementing the probing prompting learning model is 96.30%. This aligns with Purwanto's (2009), stating that the activity percentage criteria between 86%

and 100% fall within the very good implementation of probing prompting learning model activities.

Additionally, this study examined the enhancement of mathematical concept understanding by implementing the probing prompting learning model. Swasono et al. (2014) conducted research supporting the notion that the probing prompting learning model can effectively enhance students' grasp of mathematical concepts. The improvement in students' mathematical understanding is evident from their achievement in essential competencies, as depicted in Figure 2.

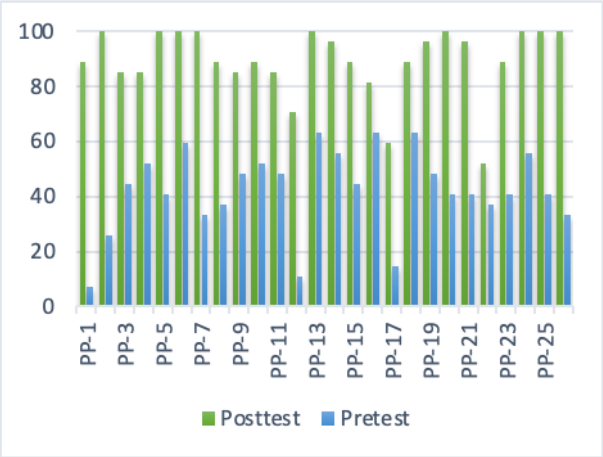

Figure 2. Basic Competency Results of Probing Prompting Learning Model

Figure 2 shows that all students have a significant increase in their mathematical understanding ability. The average results of students' overall basic abilities in the probing prompting class can be seen in Figure 3.

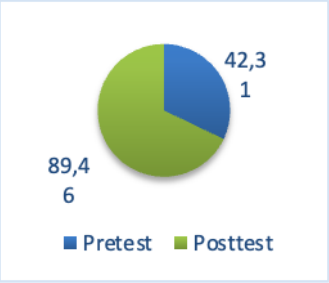

Figure 3. The Average of Basic Ability of Probing Prompting Learning Model

Based on Figure 3, students' overall average ability to understand mathematical concepts increased after learning with the probing prompting model. The average normalized gain is 0.82, indicating that students' understanding of mathematical concepts has significantly

increased (high category). Furthermore, before implementing the probing prompting learning method, the pretest results in the experimental group ranged from 7.41 to 69.96, with an average value of 42.31. Subsequently, the post-test results ranged from 52 to 100, averaging 89.46.

The analysis of the improvement of students' mathematical understanding in the control group with conventional learning can be seen from students' basic abilities. Figure 4 presents the results.

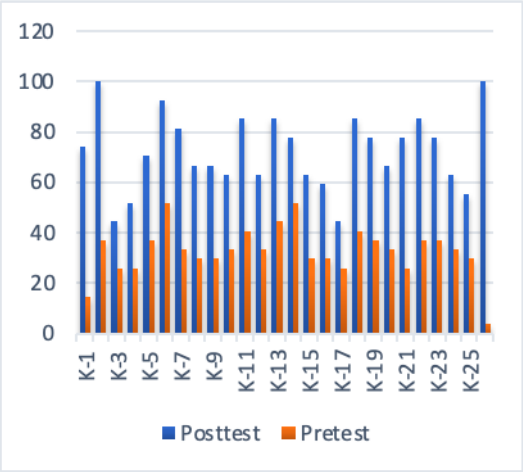

Figure 4. Basic Competency Results Conventional Learning Model

Figure 4 shows that the results of basic competency in the control class, using the conventional learning model, indicate that the lowest pretest score is 3.70, while the highest pretest score is 51.85. The average results of students' basic skills in the conventional class can be observed in Figure 5.

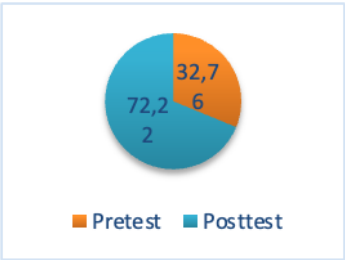

Figure 5. The Average of Basic Skills of the Conventional Learning Model

Figure 5 shows that the average mathematical concept understanding ability of students increased. The data analysis results yielded an average normalized gain of 0.59, indicating a moderate increase in students' ability to comprehend mathematical concepts with

the conventional learning model. In addition, the pretest results in the control group ranged from 3.70 to 51.85, with an average of 32.76. Meanwhile, the post-test score ranged from 44.44 to 100, with an average value of 72.22.

Furthermore, this study analyzed the differences in improving students' understanding of mathematical concepts (paired sample t-test) using normalized gain values. The aim is to determine whether the average increase in mathematical concept understanding abilities between probing prompting and conventional learning models is significantly different. The outcomes of the t-test analysis are presented in Table 3.

Table 3. T-test of Normalized Gain Data

Percentage (%)		*T-test for Equality of Means*	
		df	*Sig. (2-tailed)*
Mathematical Concept Understanding Ability	*Equal variances assumed*	50	0.000
	Equal variances not assumed	49.934	0.000

Drawing from the analysis outcomes displayed in Table 3, the difference between the two models is significant (p=0.005), and thus, H_0 is rejected. It can be concluded that there is a significant difference in improving the ability to understand mathematical concepts between students obtaining probing prompting learning models and those using conventional learning.

Moreover, the analysis of the average attitude scores aims to assess students' attitudes toward learning mathematics with the probing prompting learning model. This assessment involves calculating the average percentage value based on students' responses using the probing prompting learning model in mathematics education. Further information is available in Table 4.

Table 4. Percentage of Student Attitudes with The Probing Prompting Model

Average Percentage of Responses (%)	
Positive	Negative
63.14%	36.86%

Table 4 shows that approximately 77.88% of students were positive towards understanding mathematical concepts. This positivity was evident through their active participation and engagement in answering the questions. Meanwhile, 22.12% of students did not have a positive attitude towards the mathematical concept understanding questions given, as indicated by their responses, stating that the questions provided in the lesson were not perceived as valuable in their daily lives.

The data analysis results indicate a significant effect of applying the probing prompting learning model related to student competency achievement, resulting in substantial differences in student achievements. Additionally, there is an improvement in the average essential ability in student learning outcomes, implying an overall enhancement in student scores. This is consistent with Muna and Afriansyah (2018), who suggested that mathematical understanding can be improved through learning models aligned with students' cognitive development. One such model considered effective in enhancing students' ability to understand mathematical concepts is the probing prompting model (Swasono et al., 2014).

The average normalized gain data results reveal differences in the ability to understand mathematical concepts between students who received probing prompting learning models and those who underwent conventional learning. This discrepancy arises because applying the probing prompting learning model encourages students to actively prepare their answers and arguments in response to the teacher's questions. This is supported by Fuadi et al. (2016), who propose that to reduce the weak concept understanding ability in mathematics learning, students need to be accustomed to providing arguments for each answer and responding to the answers given by others.

CONCLUSION

In this research, the probing prompting learning model can be an effective alternative for facilitating learning and improving students' understanding of mathematical concepts. The findings indicate the following: (1) The average percentage of teacher activity was 96.30% (“very good” category); (2) The t-test analysis findings showed a significant difference in the enhancement of understanding of mathematical concepts between students exposed to the probing prompting learning model (high category) and those using conventional learning approach; (3) Students responded positively to the probing prompting learning model, as evidenced by their attitude.

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