

ENHANCING MATHEMATICAL UNDERSTANDING ABILITY, CREATIVE THINKING SKILLS AND SELF CONFIDENCE THROUGH OPEN-ENDED APPROACH ON JUNIOR HIGH SCHOOL STUDENTS

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ARTICLE INFO

Article history:

Received Jul 27, 2024

Revised Aug 17, 2024

Accepted Aug 25, 2024

Keywords:

Mathematical
Understanding Ability
Creative Thinking Skills
Self Confidence
Open-Ended Approach

ABSTRACT

The open-ended approach in mathematics education has been proven effective in enhancing deeper understanding, creative thinking skills, and student self-confidence by encouraging exploration and allowing multiple solutions. This study aims to evaluate the effectiveness of the open-ended approach in improving mathematical understanding, creative thinking skills, and self-confidence among junior high school students, as well as to identify specific strategies within this approach that most significantly contribute to these educational outcomes. The research employed a quasi-experimental design with a pre-test and post-test control group. Participants were junior high school students divided into two groups: an experimental group that received instruction using the open-ended approach and a control group taught using traditional methods. Data were collected through tests measuring mathematical understanding, creative thinking skills, and self-confidence, administered before and after the intervention. Statistical analysis of the results indicated that students in the experimental group showed significant improvement in mathematical understanding, creative thinking skills, and self-confidence compared to the control group. This study concludes that the open-ended approach is more effective than traditional teaching methods in enhancing these educational outcomes among junior high school students. The findings highlight the importance of implementing the open-ended approach in mathematics education to provide more meaningful learning experiences and better prepare students for complex problem-solving tasks.

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How to Cite:

Desi, D., Putra, H.D., Hendriana, H. (2025). Enhancing Mathematical Understanding Ability, Creative Thinking Skills and Self Confidence through Open-Ended Approach on Junior High School Students. *JIML*, 8(1), 91-99.

INTRODUCTION

Mathematics learning today is experiencing quite a significant translation with developments in the times that are moving increasingly exponentially (Chytry & Kubiato, 2021; Dolapcioglu & Doğanay, 2022; Mainali, 2021; Nopriana et al., 2021; Yuliani et al., 2020). The role of technology in this era allows students to think more complexly by utilizing existing information sources that can be obtained without being hindered by time and space (Haleem et al., 2022; Hubers et al., 2022; Sirojuddin, 2023; Souza & Debs, 2024; Waycott, Jenny & Bennett, Sue & Kennedy, Gregor & Dalgarno, Barney & Gray, 2010). So this allows for a new paradigm in mathematics learning to eliminate conventional-based learning models (Al Ayyubi, Bukhori, et al., 2024; Al Ayyubi, Hayati, et al., 2024; Al Ayyubi, Rohaendi, et al., 2024). This is intended to increase students' mathematical understanding which can be correlated with their self-confidence and creativity (Asrafzani et al., 2022; He et al., 2023; Setiadi et al., 2023). The ability to understand the mathematics that students have will be vital to their self-confidence and make students more creative in understanding open problems.

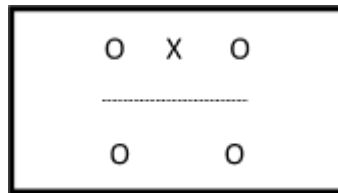
Apart from that, it is still found that many students' mathematical understanding abilities are relatively low (Farhana et al., 2023; Febriyani et al., 2022; Hakim, 2019; Kamilah & Awalludin, 2021; Widana & Diartiani, 2021). This results in students' lack of self-confidence and relevance in their creative thinking abilities when solving mathematical problems at school, especially at the lower secondary school level. Based on this, efforts are needed to improve students' mathematical understanding, creative thinking, and self-confidence in mathematics with approaches and learning models that can be said to be appropriate. One approach that can optimize students' mathematical understanding, creative thinking, and self-confidence is to apply an open-ended approach. This is because, with the open-ended approach, students are not required to solve problems with a single answer or way of thinking (Mufanti et al., 2024). So that with this approach students can understand the learning material by being required to think more openly and support students' creativity in solving mathematical problems with optimum self-confidence.

Then previous research studied more about the open-ended approach in the application of technical mathematics learning. Such as answering open-ended mathematical problems, allowing theoretical correlation of the open-ended approach with mathematics philosophically, to analyzing the mathematical learning outcomes of students whose learning uses the open-ended approach in descriptive statistics (Auliya et al., 2022; Hartati et al., 2020; Mainali, 2021; Nopriana et al., 2021; Sari & Surya, 2017; Sukarna et al., 2020). So there are still not many studies that have conducted research applying mathematical learning with an open-ended approach to students' understanding abilities, students' creative thinking, and maximizing students' self-confidence. The open-ended approach is applied only partially to these three variables, so this becomes a novelty value in the research carried out by integrating them comprehensively.

Thus, to fill the gaps in previous research, this research aims to improve students' mathematical understanding, creative thinking, and self-confidence with an open-ended approach. Mathematics learning in this era focuses on student-centered centered, leaving behind the old paradigm which is still teacher-centered. This is marked explicitly by the independent curriculum which has recently been proposed as a reference for its equivalence with current developments. With the open-ended approach used in mathematics learning, it is hoped that students will be able to think more macro and not only assume that mathematical problems can only be solved by thinking single or binary. So that with this, students can further activate their creativity and self-confidence in understanding mathematics problems which can be implemented in their daily lives.

METHOD

The approach used in this research is the quantitative approach. A quantitative approach is a research method based on positivist philosophy, used to study a specific population or sample, with data collection using research instruments and quantitative/statistical data analysis aimed at testing established hypotheses (Sugiyono, 2016, 2021). The method used in this research is the quasi-experimental method. This study involves two groups: the experimental group and the control group. The experimental group received mathematics instruction using the open-ended approach as the treatment, while the control group received the usual mathematics instruction using the scientific approach. Therefore, the design used in this study is the Non-Equivalent Control Group Design, as shown in the following figure.



The population in this research includes all junior high school students in SMPK in West Bandung Regency, with the sample subjects being one SMPK in West Bandung Regency selected through purposive sampling. Purposive sampling refers to selecting groups based on specific considerations. The sample consists of two classes, with class VII A serving as the experimental group that will receive instruction using the open-ended approach, and class VII B serving as the control group that will receive regular instruction.

RESULTS AND DISCUSSION

Results

Table 1. Recapitulation of Mathematics Learning Results using an Open Ended Approach

Mathematical Ability	Information	Experiment			Control		
		Pretest (%)	Posttest (%)	N-Gain	Pretest (%)	Posttest (%)	N-Gain
Mathematical Understanding Ability	$\bar{x}$	72.1	87.8	0.78	65.3	67.7	0.66
	s	2.6	1.9		2.0	1.4	
Creative Thinking Skills	$\bar{x}$	81.3	89.1	0.75	67.2	68.9	0.68
	s	2.4	1.8		1.5	0.9	
Self Confidence	$\bar{x}$	70.29			67.12		
	s	0.8			1.1		

Based on the output in the table above, it can be seen that the average value and standard deviation in the control and experimental classes have increased which can be reviewed based on the pretest and posttest. The students' mathematical understanding ability in the control class got an average score in the pretest and posttest of 65.3 and 67.7 with a standard deviation value of 2.0 and 1.4 and in the experimental class, it was 72.1 and 87.8 with a standard deviation value of 2.6 and 1.9. Meanwhile, the creative thinking ability of students in the control class obtained an average score in the pretest and posttest of 67.2 and 68.9 with a standard deviation value of 1.5 and 0.9, and in the experimental class, it was 81.3 and 89.1 with a standard deviation value of 2.4 and 1.8. Meanwhile, for students' self-confidence, the average scores obtained after learning in the control and experimental classes were 67.12 and 70.29 with standard deviation values of 1.1 and 0.8. However, these descriptive statistics need to be further

proven by inferential statistical testing with parametric or non-parametric tests depending and the normalization of the data obtained as follows.

Table 2. Data Normality Test Recapitulation

Mathematical Ability	Information	Control		Experiment	
		Pretest	Posttest	Pretest	Posttest
Mathematical Understanding Ability	Sig.	0.200	0.200	0.200	0.200
Creative Thinking Skills		0.200	0.200	0.200	0.200
Self Confidence			0.200		0.200

Based on the statistical output above, it can be seen that the significance value for both mathematical understanding, creative thinking, and student self-confidence shows a value of 0.200 or greater than 0.05. So it can be said that the scores on mathematical understanding, creative thinking, and student self-confidence are normally distributed. Next, a homogeneity test is carried out to see whether there is the same variance or not in student learning outcomes using open-ended learning.

Table 3. Recapitulation of Homogeneity Test with Levene's Test

Mathematical Ability	Levene Statistic	Control		Experiment	
		Pretest	Posttest	Pretest	Posttest
Mathematical Understanding Ability	Sig.	0.052	0.060	0.062	0.055
Creative Thinking Skills		0.070	0.053	0.112	0.173
Self Confidence			0.710		0.83

Based on the statistical output above, it can be seen that the significance value for both mathematical understanding, creative thinking and student self-confidence shows a value greater than 0.05. So it can be said that the scores on mathematical understanding, creative thinking, and student self-confidence have the same or homogeneous variance. Next, a t test was carried out to see whether there were differences in student learning outcomes using the open ended approach.

Table 4. Recapitulation of T test

Mathematical Ability	t-test	Control		Experiment	
		Pretest	Posttest	Pretest	Posttest
Mathematical Understanding Ability	Asyim. Sig. (2-tailed)	0.001	0.000	0.000	0.000
Creative Thinking Skills		0.000	0.000	0.006	0.002
Self Confidence			0.001		0.000

Based on the statistical output above, it can be seen that the significance value for both mathematical understanding, creative thinking and student self-confidence shows a value that is smaller than 0.05. So it can be said that the scores on mathematical understanding, creative thinking, and student self-confidence have an average difference when learning mathematics using an open ended approach. So it can then be seen whether there is an improvement between the mathematical abilities applied in the open ended approach and the N-Gain test.

Table 5. N-Gain Test Recapitulation

Mathematical Ability	Information	N-Gain
Mathematical Understanding Ability	Asym. Sig. (2-tailed)	0.002
Creative Thinking Skills		0.030

Based on the statistical output above, it can be seen that the significance value for the ability to understand mathematics and think creatively is 0.002 and 0.030 or can be said to be smaller than 0.05. So it can be concluded that in mathematical learning students using an open ended approach to mathematical understanding and creative thinking students have a significant improvement or in other words the treatment in the experimental class is better than in the control class.

Discussions

The study suggests that open-ended learning at SMPK BPK Penabur KBP Bandung can enhance students' creative thinking skills by allowing them to express creative ideas in problem-solving freely. Creative thinking combines logical and divergent thinking to produce novel ideas, a skill essential in the Merdeka curriculum. Educators must foster creativity in students, and open-ended learning is a suitable approach for this. Initially, students showed low creative thinking skills, as they provided only standard solutions or none at all in the pretest. Panjaitan & Surya (2017) suggest that creative thinking can be measured through fluency, flexibility, and originality. Enhancing these components improves students' ability to understand problems and solve them in various, unique ways.

After implementing open-ended learning, students demonstrated significant improvement in fluency, flexibility, and originality, as seen in their posttest scores. The experimental class showed a substantial increase in creative thinking skills, reflecting the positive impact of open-ended learning (Al Ayyubi, Rohmatulloh, et al., 2024; Hassobah, 2004; Shafina et al., 2020). The difference in learning approaches between open-ended and traditional methods leads to varying impacts on students' creative thinking abilities. Open-ended learning offers students the freedom to explore ideas and develop problem-solving strategies, fostering creativity. In contrast, control classes restrict this freedom, focusing on single-answer solutions and limiting the exploration of diverse ideas and strategies. By incorporating open-ended learning approaches into the learning process, students can more easily understand the material. The results indicate that open-ended learning significantly enhances students' creative thinking skills, which are crucial and should be nurtured at all educational levels, especially in junior high schools.

Using open-ended learning as an alternative in elementary schools can help improve students' creative thinking skills. Embracing open education principles allows students to engage in self-directed learning, explore different perspectives, and develop innovative solutions to problems. This approach fosters critical thinking, problem-solving abilities, and creativity, better preparing students for future challenges. From the results of research that has been carried out, students' mathematical understanding abilities after learning using an open-ended approach can improve significantly compared to conventional learning. The results of the data processing also concluded that there were indeed differences in achievement and improvement in the ability to understand and think creatively in mathematics as well as the self-confidence of students who used the open-ended approach and those who used regular learning. This can happen due to several factors, including differences in learning steps in the open ended approach and scientific learning. This is in line with research conducted by (Suriyadi, 2019)

which concluded that the open ended approach was effective in developing students' creative mathematical thinking abilities. In addition, Agustina et al. (2021) concluded that the open-ended approach was able to improve students' creative mathematical thinking abilities.

Apart from improving students' cognitive abilities, learning with an open-ended approach can also improve affective abilities, namely self-confidence. The results of data processing show that students' self-confidence increases after learning with an open-ended approach. This shows that learning using an open ended approach can be used to increase students' self-confidence. This is in line with research conducted by Rochman & Amir (2023) which concluded that the classroom atmosphere used an open ended approach. Apart from that, Andriani et al. (2015) concluded the results of their research that the self-confidence of students who used an open-ended learning approach was better than those who used conventional learning.

CONCLUSION

The study demonstrates that the open-ended approach significantly enhances junior high school students' mathematical understanding, creative thinking skills, and self-confidence. The results show that students exposed to open-ended problems not only improve their grasp of mathematical concepts but also exhibit greater flexibility in problem-solving and a more innovative mindset. Additionally, the open-ended approach fosters a positive learning environment that boosts students' self-confidence by encouraging exploration and reducing the fear of making mistakes. These findings suggest that integrating open-ended tasks into mathematics instruction can lead to more engaged and confident learners, better prepared to tackle complex problems in both academic and real-world contexts. Future research should continue to explore and refine strategies for implementing open-ended approaches to maximize their benefits in diverse educational settings. Before the introduction of open-ended learning, students' creative thinking abilities at SMPK BPK Penabur KBP Bandung were generally low. However, after applying this method, their creative thinking abilities significantly improved, reaching a high level. Thus, it can be concluded that the open-ended learning approach is effective in enhancing the creative thinking abilities of students at SMPK BPK Penabur KBP Bandung.

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