Journal of Mathematics Education
Website: http://usnsj.id/index.php/JME
Email: pengelolajme@gmail.com
p-ISSN 2528-2468; e–ISSN 2528-2026

DOI: https://doi.org/10.31327/jme.v11i1.2777

THE IMPLEMENTATION OF THE PROBLEM BASED LEARNING MODEL WITH A CONTEXTUAL APPROACH TO IMPROVE MIDDLE SCHOOL STUDENTS CREATIVE THINKING SKILLS

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Article Info

Article history:

Received Mei 18, 2026
Revised Mei 28, 2026
Accepted Jun 01, 2026

Keywords:

Problem Based Learning;
Contextual Approach;
Creative Thinking.

ABSTRACT

This study aims to analyze the effectiveness of implementing the problem-based learning model with a contextual approach in improving students mathematical creative thinking skills. This research employed a pre-experimental design using a one-group pretest–posttest approach involving 30 eighth-grade students in Yogyakarta, selected through purposive sampling. The research instruments consisted of a mathematical creative thinking test and an observation sheet. The results showed a significant difference between students pretest and posttest scores based on a paired t-test with a significance value of $0.001 < 0.05$. Furthermore, the one-sample t-test results indicated that the average students mathematical creative thinking ability had reached the predetermined mastery criteria, with a significance value of $0.001 < 0.05$. In addition, the proportion test showed that classical learning mastery was achieved, with a significance value of $0.010 < 0.05$, where at least 75% of students reached the mastery criteria. Meanwhile, the effect size analysis using Cohen's d revealed a value of 1.832, which is categorized as a large effect. Thus, it can be concluded that the integration of the Problem-Based Learning model with a contextual approach is effective in improving students mathematical creative thinking skills and supports active engagement in learning.

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How to Cite:

Rizky, V., Arliani, E., & Hidayatullah, S. (2026). The Implementation of The Problem Based Learning Model With A Contextual Approach to Improve Middle School Students Creative Thinking Skills. *JME:Journal of Mathematics Education*, *11*(1), 194-203.

1. INTRODUCTION

21st-century competencies for students are essential assets in preparing for a future full of challenges and changes. Skills such as critical thinking, creativity, collaboration, communication, character, and citizenship (6C) serve as the main foundation for facing global developments. Therefore, education must be designed to optimally develop these competencies so that students are able to adapt, innovate, and actively contribute to everyday life (Amelia et al., 2026; Suyitno, 2020). One of the most important skills to develop is creativity, as it enables students to generate new ideas, identify various alternative solutions, and address problems in flexible and innovative ways (Suherman, 2024; Suherman & Vidákovich, 2022).

In the learning context, creativity is manifested through creative thinking skills, which include fluency, flexibility, originality, and elaboration. These skills enable students not only to understand concepts conceptually but also to generate new ideas, modify ideas, and develop deeper, relevant, and meaningful solutions in response to problems across various contexts (Sipahi & Bahar, 2025; Zioga & Desli, 2025). However, various studies indicate that students creative thinking abilities are still in the low to moderate category. Research conducted by Hidajat, (2021); Junaedi et al., (2021) shows that students mathematical creative thinking skills are in the moderate category, with 14% in the high category, 69% in the medium category, and 17% in the low category. In addition, findings from Handayani et al., (2020) show that 88.2% of students achieved the fluency indicator, 23.5% met the flexibility indicator, and none of the students achieved the novelty indicator. These findings indicate that the development of mathematical creative thinking skills is not yet optimal and still requires innovation in the learning process.

This condition reveals a gap between the demands of a curriculum based on higher-order thinking skills and classroom practices that are still teacher-centered and procedure-oriented (Korkmaz & Altay Öztürk, 2025). Therefore, a learning model that actively engages students is needed, one of which is Problem-Based Learning (PBL). This model places problems as the trigger for learning and has been proven effective in improving creative thinking skills. Research by Kardoyo et al., (2020); Yunita et al., (2020) shows that the implementation of the Problem-Based Learning model significantly improves students mathematical creative thinking skills, as indicated by improvements in fluency, flexibility, and originality. Furthermore, studies by Selvy et al., (2020); Widiastuti et al., (2023) show that students taught using the Problem-Based Learning model have higher levels of creative thinking skills compared to those in conventional learning, particularly in generating various alternative solutions.

Although Problem-Based Learning has been widely reported as effective in improving higher-order thinking skills, including mathematical creative thinking, existing empirical studies still predominantly focus on the implementation of learning syntax. According to Rézio et al., (2022); Siagian et al., (2019) the quality and context of the problems used in Problem-Based Learning have received relatively little attention. The problems presented tend to be abstract and non-contextual, so they are not yet able to optimize students exploration of ideas and development of creativity. Therefore, an approach is needed to strengthen the implementation of Problem-Based Learning, namely the contextual approach.

The contextual approach emphasizes the relationship between learning materials and students real-life situations, making the problems presented more meaningful and relevant (Haryanto & Arty, 2019; Maryani & Widjajanti, 2020). Through the integration of real-life contexts, students are encouraged to actively construct knowledge, explore various solution strategies, and produce more diverse and creative ideas. On the other hand, the contextual approach has the potential to enhance engagement and meaningful understanding (Masruroh et al., 2020; Szabo et al., 2020). However, studies that integrate Problem-Based Learning with a contextual approach are still limited, particularly in examining its impact on mathematical creative thinking skills.

Based on this research gap, this study offers novelty through the systematic integration of Problem-Based Learning with a contextual approach by placing contextual problems at the core of learning. This integration is expected to promote active knowledge construction and generate more diverse, flexible, and original solutions, while also providing empirical contributions to the development of more meaningful mathematics learning. The purpose of this study is to analyze the effectiveness of implementing the Problem-Based Learning model with a contextual approach in improving students mathematical creative thinking skills. The results of this study are expected to contribute empirically to the development of more innovative, meaningful, and relevant mathematics learning in the 21st century.

2. METHOD

This study employed a pre-experimental approach using a One-Group Pretest-Posttest Design (Creswell & Creswell, 2022). This design was chosen to examine the effectiveness of implementing the Problem-Based Learning model with a contextual approach on students mathematical creative thinking skills through the comparison of pretest and posttest results. The population of this study consisted of all eighth-grade students at one public junior high school in Yogyakarta. The sample was selected using a purposive sampling technique based on expert and mathematics teacher judgment, with the following criteria: (1) students were in a class with heterogeneous academic abilities, (2) students had completed prerequisite material relevant to the research topic, and (3) the class showed a sufficient level of active participation in the learning process. The selected sample was class VIII A, consisting of 30 students. The research instrument was a mathematical creative thinking test in the form of essay questions developed based on indicators, namely fluency, flexibility, elaboration, and originality (Torrance & Ball, 1984).

Prior to use, the instrument was validated by two mathematics education experts to ensure content validity. The validation process included assessing the alignment of items with indicators of mathematical creative thinking, clarity of language, and accuracy of mathematical content. Subsequently, a pilot test was conducted on students outside the research sample to examine the instrument's reliability. Reliability was calculated using Cronbach's Alpha coefficient, and the instrument was considered reliable because it obtained a coefficient greater than 0.60 (Retnawati, 2016). In addition, a scoring rubric was developed to systematically assess students responses based on the four indicators of creative thinking skills.

Data collection was conducted through pretest and posttest administration as well as classroom observation during the learning process. The pretest was administered prior to the treatment to determine students initial mathematical creative thinking ability. The treatment was then implemented through the Problem-Based Learning model integrated with a contextual approach over six meetings. During the learning process, students were given contextual mathematical problems related to real-life situations to encourage active knowledge construction, collaborative problem-solving, and the exploration of various solution strategies. After the treatment was completed, a posttest was administered to determine changes in students mathematical creative thinking abilities.

The effectiveness of the learning process was determined based on two criteria. First, students were considered to have achieved mastery learning if they obtained a minimum score of 74.99 according to the Minimum Competency Criteria (MCC) set by the school.

Second, the learning process was considered classically effective if at least 75% of students achieved the mastery criterion.

Data analysis was conducted using inferential statistical techniques with a significance level of 0.05. Prior to hypothesis testing, a normality test was first conducted using the Shapiro–Wilk test to determine whether the data were normally distributed. The normality test was applied to the difference scores because the main analysis of the study employed a paired-sample t-test.

After the data were confirmed to be normally distributed, a paired-sample t-test was conducted to determine whether there was a significant difference between students pretest and posttest scores after the treatment. Furthermore, a one-sample t-test was conducted to determine whether the average posttest score exceeded the predetermined MCC value of 74.99. In addition, a proportion test was conducted to determine whether at least 75% of students achieved mastery learning classically.

To determine the magnitude of the effect of the Problem-Based Learning model with a contextual approach on students mathematical creative thinking skills, an effect size analysis using Cohen's d was conducted. The Cohen's d value was calculated based on the mean difference between pretest and posttest scores divided by the pooled standard deviation. The interpretation of effect size followed criteria Cohen, (1988), where 0.20 is considered a small effect, 0.50 a medium effect, and 0.80 or higher a large effect.

All statistical analyses were performed using R Studio software. This study was conducted after obtaining permission from the school principal and mathematics teacher. All students participated voluntarily, and all research data were kept confidential and used solely for academic purposes.

3. RESULTS AND DISCUSSION

3.1. Results

In this study, data analysis began with descriptive analysis, followed by inferential analysis to test the formulated hypotheses. The results of the descriptive analysis indicate that students creative thinking skills were examined based on four main indicators, namely flexibility, originality, fluency, and elaboration. The findings show an improvement across all indicators after the implementation of the learning process. This improvement reflects students enhanced ability to generate ideas, formulate strategies, and develop solutions more systematically. In detail, the comparison of the average scores for each indicator before and after the treatment is presented in Figure 1 below.

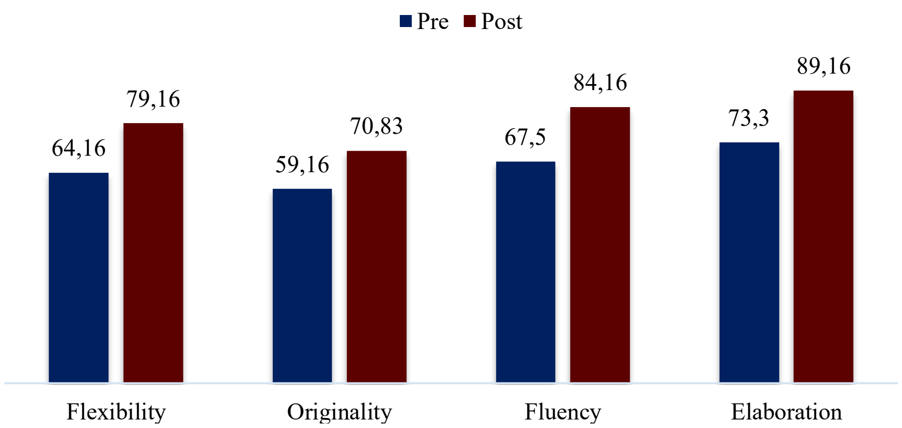

Figure 1. Comparison of Pretest and Posttest Scores for Each Creative Thinking Indicator

After conducting the descriptive analysis, the data analysis continued with prerequisite tests and hypothesis testing. The prerequisite test in this study included a normality test aimed at determining whether the data were normally distributed. The normality test was conducted using the Shapiro–Wilk test. The results of the normality test are presented in table 1.

Table 1. Normality Test Results

Data	Shapiro-Wilk	P_{value}	Interpretation
Pre-Test	0.938	0.080	H_0 accepted
Post -Test	0.933	0.061	H_0 accepted

Based on the normality test results for the pre-test and post-test data, the significance values p-value were 0.080 and 0.061, respectively. Since both values are greater than 0.05, the pre-test and post-test data were considered normally distributed. Next, a paired-sample t-test was conducted, as shown in table 2.

Table 2. Paired Sample t-Test Results

Ability	t_{value}	P_{value}	Interpretation
Creative Thinking	26,477	0.001	H_0 Rejected

Based on the results of the paired sample t-test, the obtained significance value was p-value 0,001 < 0,05 so H_0 was rejected. This result indicates a significant difference between the pretest and posttest scores. Therefore, it can be concluded that the implemented learning model has a significant effect on improving students creative thinking skills. Furthermore, a one-sample t-test was conducted to examine the achievement of the predetermined criteria, and the results are presented in table 3.

Table 3. One-Sample t-Test Results

Ability	t	P_{value}	Interpretation
Creative Thinking	4.071	0.001	H_0 Rejected

Based on the results of the one-sample t-test, the obtained significance value was p-value 0,001 < 0,05 so H_0 was rejected. This result indicates that the average students creative thinking ability is significantly higher than the predetermined criterion value of 74.99. Therefore, it can be concluded that students creative thinking ability has met the criteria set in this study. Furthermore, a proportion test was conducted, and the results are presented in table 4.

Table 4. Proportion Test Results

Ability	Z_{value}	P_{value}	Interpretation
Creative Thinking	5.377	0.010	H_0 Rejected

Based on the results of the proportion test, the calculated Z_{value} was 5,377 with a significance p-value 0,010 < 0,05, so H_0 was rejected. This result indicates that the proportion of students who achieved the creative thinking ability criteria is more than 75%. Furthermore, the effect size analysis using Cohen's d shows a value of 1.886, which is classified as a large effect. The 95% confidence interval ranges from 1.648 to 2.124, indicating a strong and consistent effect. Therefore, it can be concluded that the implementation of the Problem-Based Learning model with a contextual approach is effective in improving students creative thinking achievement.

Based on the results of the data analysis and hypothesis testing, the implementation of the Problem-Based Learning model with a contextual approach has been proven effective in improving students creative thinking skills. This is supported by the fulfillment of effectiveness criteria, indicating that the model is suitable as an alternative mathematics learning strategy to develop students creative thinking skills through continuous evaluation.

3.2. Discussion

The results of the study show that the implementation of the Problem-Based Learning model with a contextual approach has a positive effect on improving students creative thinking skills. This finding is indicated by the increase in post-test scores compared to pre-test scores after the learning implementation. The improvement is also shown by the increase in creative thinking indicators, where flexibility increased by 23.38%, originality by 19.73%, fluency by 24.68%, and elaboration by 21.64%. These findings indicate that contextual problem-based learning is effective in encouraging students to think more flexibly, generate original ideas, express ideas fluently, and develop solutions systematically in mathematics learning. The improvement in each indicator is supported by students written responses, as shown in the following figures.

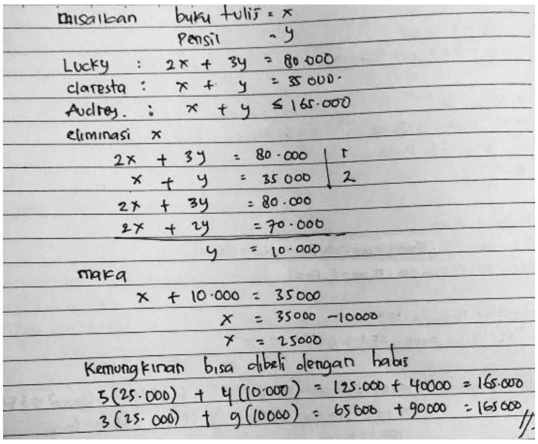

Figure 2. Students Responses for Fluency Indicator

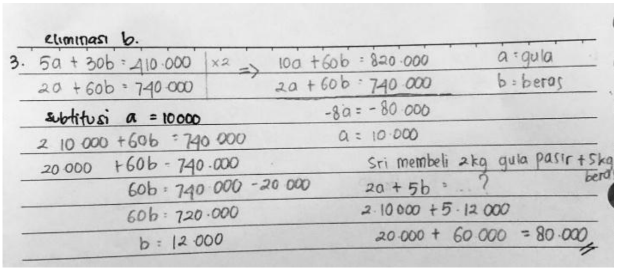

Figure 3. Students Responses for Elaboration Indicator

In figure 2, students answers demonstrate the fluency indicator, as they were able to solve problems smoothly and systematically. Students identified key information, defined variables, and constructed a system of linear equations correctly. The elimination and substitution processes were carried out in a structured manner until the correct solution was obtained. In addition, students were able to extend their solution by determining possible quantities of items based on the problem context. This shows students fluency in generating ideas and solution strategies without significant difficulties.

Meanwhile, figure 3 illustrates the elaboration indicator through students ability to develop detailed and structured solutions. Students wrote complete solution steps starting from equation formation, elimination process, to conclusion drawing. The detailed explanation shows that students not only understood the procedure but were also able to explain the logical relationships between steps, making their mathematical thinking process clear and easy to follow.

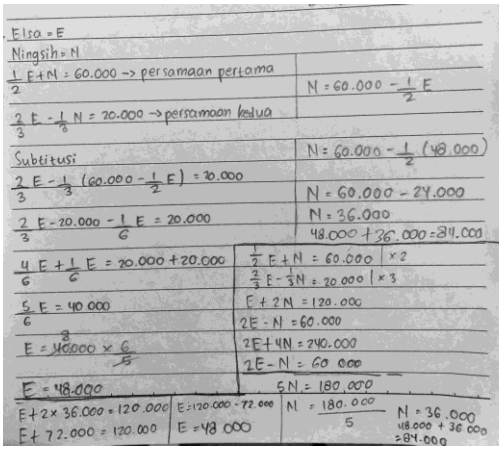

Figure 4. Students Responses for Flexibility Indicator

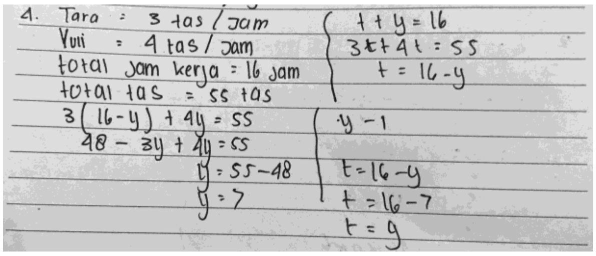

Figure 5. Students Responses for Originality Indicator

In figure 4, students answers demonstrate the flexibility indicator, as they were able to apply and adjust multiple solution strategies to obtain the correct answer. Students formed two equations from the given information and then transformed them and applied substitution step by step until the correct result was obtained. This ability to select appropriate strategies and adapt solution steps shows flexibility in mathematical thinking.

Meanwhile, figure 5 illustrates the originality indicator through the use of a simple yet effective solution strategy. Students directly applied substitution to determine variable values without using lengthy elimination procedures. This approach shows a different but logical and correct method compared to conventional procedures. It indicates students ability to generate efficient and original strategies in solving mathematical problems.

Based on the explanation above, the improvement in students creative thinking skills is closely related to the learning model applied in the classroom. This is further supported by previous research findings showing consistent results. Studies by Hamid et al., (2024); Toheri et al., (2020) show that contextual problem-based learning provides opportunities for students to connect mathematical concepts with real-life situations, making learning more meaningful and improving all indicators of creative thinking, especially fluency, flexibility, and novelty. Furthermore, research by Kardoyo et al., (2020); Simanjuntak et al., (2021) shows that Problem-Based Learning with contextual problems has a positive impact on improving students creative thinking skills because students are trained not only to find final answers but also to develop multiple possible solutions systematically.

In addition to improving creative thinking skills, the implementation of Problem-Based Learning with a contextual approach also contributes to increasing students engagement in the learning process. Students show more active participation because the problems provided are contextual and related to their real-life experiences. This active involvement is an important factor in mathematics learning because students are given the opportunity to explore ideas freely without relying entirely on teacher explanations. In line with research byAfni & Hartono, (2020); Ahdhianto et al., (2020) context-based Problem-Based Learning enhances student engagement because students perceive the problems as relevant to their daily lives, thus increasing participation in group discussions and problem-solving activities. Moreover, research by Ng et al., (2020); Pangemanan, (2020) hows that contextual approaches in Problem-Based Learning provide space for students to independently explore various solution strategies. This condition increases students confidence and learning independence, as they not only receive information but also construct their own knowledge through learning experiences.

The implementation of the Problem-Based Learning model with a contextual approach requires careful lesson planning. Teachers are required to design contextual problems that are appropriate to students ability levels and learning objectives. In addition, time management, group discussion facilitation, and classroom management are important aspects to ensure effective learning. Without optimal management, the investigation process in Problem-Based Learning may require more time compared to conventional learning.

However, this study has several limitations. First, the sample used is relatively limited, which may affect the generalizability of the research findings. Second, this study did not include a control group, so the results only describe changes in the experimental class. Despite these limitations, this study has several important implications. Practically, teachers can use the Problem-Based Learning model with a contextual approach as an alternative learning strategy to improve students creative thinking skills in mathematics learning. From the perspective of mathematics education development, this model supports student-centered learning by integrating real-life contexts, thereby encouraging higher-order thinking skills.

Furthermore, for future research, it is recommended to involve a larger and more diverse sample, use a control group, and extend the duration of the intervention in order to obtain more comprehensive and generalizable results.

4. CONCLUSION

Based on the results of the analysis and discussion, it can be concluded that the research problem related to students low creative thinking skills prior to the implementation of learning has been addressed through the implementation of the Problem-Based Learning model with a contextual approach. The application of this model has been proven to improve students creative thinking skills across all indicators, namely fluency, flexibility, originality, and elaboration. This improvement indicates that contextual problem-based learning provides opportunities for students to be more active in exploring ideas, developing various solution strategies, and connecting mathematical concepts with real-life situations. In addition, students became more engaged in the learning process because the problems presented were relevant to their daily experiences. Thus, it can be emphasized that the Problem-Based Learning model with a contextual approach is effective in improving students creative thinking skills while also creating a more active, meaningful, and student-centered learning process in mathematics classrooms.

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