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Improving Mathematical Problem-Solving Junior High School Through Contextual Teaching and Learning

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Abstract. This study aims to compare the improvement in mathematical problem-solving skills between students using a contextual approach and those using conventional learning. The research focuses on the Initial Mathematical Ability (KAM) category of high-ability students. A quasi-experimental design was employed, with a non-equivalent pre- and post-test control group. The Two-Way Anova test was utilized for data analysis, with a significance value of 0.003. The results showed a significant difference in improving mathematical problem-solving ability between the two groups. The contextual approach proved particularly beneficial for high-ability students. However, it is essential to consider other factors influencing improvement. This study provides insights into effective mathematics instruction, emphasizing the importance of relevant and applicable learning experiences to enhance problem-solving abilities. Further research should explore long-term effects and adaptation for students with varying initial abilities. These findings contribute to developing more effective mathematics curricula and learning strategies, ultimately improving students' problem-solving skills.

Introduction

Mathematics holds a significant role within educational institutions as a fundamental component that encompasses abstract concepts and maintains consistency throughout the teaching and learning process. Its purpose is to mould each individual into a productive member of society, thereby contributing as a valuable asset in advancing the nation and state, both presently and in the future. The teaching and learning process can be viewed as a form of socialization, wherein students are exposed to various subjects, including science and the environment, to cultivate their abilities and prepare them to actively contribute to the progress of their nation and state, both presently and in the future. Individuals must actively engage in societal development by assuming roles and participating in the process of development within society. According to Depdiknas (2006), the primary goals of mathematics education at the elementary, junior high, high school, and vocational school levels are centred around problem-solving. These objectives encompass the development of skills such as problem comprehension, mathematical modelling, model resolution, and the interpretation of obtained solutions.

This prompt requests an academic interpretation of the solution that has been obtained. The ability to solve problems is closely associated with the attributes of mathematics, which is categorized as a form of higher-order thinking—a profound level of cognitive processing. According to Herman (2000: 7), Polya provided his viewpoint. In general, problem-solving skills can be categorized into four distinct phases, the first of which involves comprehending the problem. Addressing a planning problem involves formulating a plan, executing the plan to resolve the problem, reflecting on the problem-solving process and conducting a retrospective analysis of problem-solving outcomes. In problem-solving, students are anticipated to demonstrate proficiency in applying mathematical principles previously

acquired and employed to resolve problems while attentively considering the sequential progression of steps undertaken.

The problem can be resolved by diligently following the predetermined steps. Nevertheless, the problem-solving skills of students in Indonesia remain subpar. The evidence supporting this claim can be found in the TIMSS survey conducted in 1999 (1999: 32). According to the survey results, Indonesia was positioned at the 34th rank out of the 38 countries that took part in the survey. The average score obtained by Indonesia was 403, which fell below the international average score of 487. In addition, the findings from the TIMSS survey conducted in 2003 (2003: 44) indicated that Indonesia was positioned at the 34th rank among the 45 participating countries. The average score obtained by Indonesia was 403, which fell below the global average score of 487. Out of the 45 countries included in the survey, the subject country ranked 34th with an average score of 411, below the international average of 467. In 2007, the findings of the TIMSS survey (2007: 53) indicated that the mean mathematics performance among eighth-grade students remained consistent across various evaluations in Italy, Jordan, Indonesia, Bahrain, and Botswana.

The geographical regions under consideration are the state of Minnesota and the province of British Columbia. In the year 2007, Indonesia experienced various socio-political and economic developments. In 2007, Indonesia's average score was 397, which remains lower than the international average of 500. The findings from the 2011 TIMSS assessment further indicated that the proficiency in mathematics among eighth-grade students in Indonesia was positioned at 38th out of 45 countries. The country ranks 38th among a total of 45 countries. Based on the findings of the survey, it was observed that the mean mathematics score was 386, indicating a decrease of 11 points compared to the scores recorded in 2007.

The Programme for International Student Assessment (PISA) survey, similar to TIMSS, seeks to evaluate students' proficiency in knowledge and mathematical abilities. In 2003, Indonesia's ranking was 38th out of 40 countries, with an average score of 360. In 2003, Indonesia was positioned at the 38th rank among 40 countries, with an average score of 360. By 2006, the average score of Indonesian students had increased to 391, resulting in a rank of 50 out of 59 countries. Similarly 2009, Indonesia's rank remained at 50 out of 59 countries. However, the same year, Indonesia's rank dropped to 61 out of 65 countries, with an average score of 371. It is worth noting that the international average score during this period was 496. According to Balitbang (2011),

According to the findings of two surveys and a study conducted by Wardani and Rumiati (2011: 1), it has been observed that a significant factor contributing to the subpar performance of Indonesian students in problem-solving tasks, specifically those resembling the questions found in TIMSS and PISA assessments, is their overall lack of adequate training in this area. PISA. The attributes of these inquiries necessitate students to employ logical thinking, persuasive discourse, and imaginative thinking in their resolution, specifically in the context of problem-solving test questions. It aligns with the findings of the Ministry of Education report (Sindi, 2012: 7). The students in our educational institution demonstrate deficiencies in their ability to effectively engage in problem-solving tasks that require the application of critical thinking, argumentation, and practical communication skills.

Another contributing factor is the insufficient emphasis on problem-solving in the mathematics learning process within Indonesian schools. The learning process undertaken by students primarily involves the repetitive application of prescribed formulas and algorithms, resulting in challenges when confronted with problem-solving tasks. This phenomenon leads to challenges for students when attempting to solve problems that are not routine. According to Turmudi (2009: 7), students have observed that the teacher did not provide an example. The learning process in the classroom does not adequately support the cultivation of students' problem-solving skills, instead focusing primarily on developing their lower-level thinking abilities—the enhancement of students' cognitive abilities at a basic level. It is imperative to employ an effective and efficient learning model to optimize the

performance and attainment of learning objectives. To effectively accomplish learning objectives, it is imperative to employ a learning approach that can effectively complement and provide support in this endeavor. An instructional methodology that can enhance and reinforce this trajectory. One of the pertinent learning approaches for facilitating the learning process is the contextual approach. The primary objective of the contextual approach is to facilitate students in establishing significant associations between the learning process and real-life situations. According to Yamin (2012: 76), contextual learning is a pedagogical approach that seeks to facilitate learners' comprehension of the subject by establishing connections between the taught content and its practical relevance in real-world situations. The subject matter and its practical applications in daily life.

The primary objective of the contextual approach is to facilitate students in establishing significant linkages between the educational process and real-world applications—establishing a significant correlation between the process of acquiring knowledge and its application in real-life situations. According to Yamin (2012: 76), contextualized learning facilitates learners' comprehension of the subject matter by establishing connections between the content and its practical relevance in real-life situations. Contextual learning aims to facilitate learners' comprehension of the subject matter by establishing connections between the content and its practical applications in real-world scenarios. The efficacy of the contextual approach is demonstrated when students can effectively apply and comprehend the subject matter being taught, drawing upon real-world problems and the specific context in which these problems arise. Including context in student learning provides a comprehensive understanding, significance, and advantageous outcomes. The contextual approach offers an authentic learning experience for every student, encompassing both practical and cognitive engagement. Students must possess a comprehensive understanding of the subject matter. The concept of learning mathematics with a contextual approach refers to integrating mathematical content with students' experiences and everyday situations, thereby equipping them with practical knowledge applicable to their lives. The material encompasses students' daily experiences and circumstances, both as individuals and within their respective communities.

Methods

The present study employed a quasi-experimental methodology, utilizing a non-equivalent pre- and post-test control group design. In this study design, research participants are not selected through randomization, but rather the researcher acknowledges and accepts the participants' conditions as they naturally exist. During the preliminary phase of the study (pre-test), the experimental group and the control group are assessed on the specific skills or variables that are the primary focus of the research before administering any intervention or treatment. The experimental group will subsequently be subjected to a distinct treatment or intervention, such as contextualized learning. In contrast, the control group remains untreated and continues to engage in conventional learning practices. Following the implementation of the treatment or intervention, a subsequent assessment (post-test) is conducted on both groups to evaluate the disparity in the skills or variables being investigated between the two groups after the administration of the treatment. This post-test measurement aims to determine whether a statistically significant difference exists between the experimental group, which was exposed to contextualized learning, and the control group, which received conventional learning. It is essential to acknowledge that the present design has certain limitations, including the possibility of bias in group allocation and challenges in extrapolating the findings to a broader population due to the non-random group of subjects. However, this design can offer a preliminary understanding of the efficacy of a specific treatment or intervention within a restricted research setting.

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Figure 1. Research Design

The study population consisted of Grade VIII students in one of the government junior high schools in Talaga, Majalengka Regency. The sample was selected through purposive sampling, where two classes were selected as the research sample. One class was chosen as the experimental group that would receive learning with a contextual approach, while the other class became the control group that would receive conventional learning. In the early stage of the research (pre-test), both groups will be measured on relevant skills or variables before they receive any learning. The experimental group will receive contextualized learning, while the control group will receive conventional learning. After the implementation of the learning, both groups will be measured again (post-test) to assess the difference in skills between the two groups after receiving the learning. The data collected will be processed and analyzed using appropriate statistical methods to compare the post-test results between the experimental and control groups. Thus, this study will provide insight into the effectiveness of learning with a contextual approach to the skills of VIII-grade students in a particular area compared to conventional learning. The results of this study are expected to provide critical information for developing more effective learning approaches in the future.

Results And Discussion

This study compared the improvement of mathematical problem solving skills of students whose learning used a contextual approach and those whose learning used conventional learning. The analysis was conducted by considering the high students' Initial Mathematical Ability (KAM) category. This study aimed to determine whether there was a significant difference in the improvement of mathematical problem-solving ability between the two groups of students. The method used in this research is the Two-Way Anova test, with a significance value of 0.003. The test results showed that H0 (null hypothesis) was rejected, meaning there was a significant difference in the improvement of mathematical problem-solving ability between the two groups of students.

The results of this study provide support for the use of contextual approaches in learning mathematics, especially for students with high initial mathematical abilities. The contextual approach emphasizes the application of mathematics in real-world situations, which allows students to see the relevance and application of mathematical concepts in everyday life. In a scientific article, these findings can be presented as an essential part of the research, showing that learning with a contextualized approach can provide significant benefits for students with higher mathematical abilities. The research also provides essential implications for developing more effective mathematics curricula and learning strategies, emphasizing the importance of relevant and applicable learning experiences. However, although the results showed significant differences, it is also worthwhile to identify other factors that may have contributed to the differences, such as teacher and student interactions, the learning environment, and the teaching methods used. In addition, future research could explore the long-term effects of contextualized learning on students' mathematical problem-solving skills and its potential application in different levels of education.

Based on the results of the pre-test, post-test and N-gain data analysis on mathematical problem-solving skills presented previously. The following is a discussion of the research on mathematical problem-solving ability. This study aimed to determine the improvement of the mathematical problem-solving ability of students learning to use learning with a contextual approach and students learning to use conventional learning. After the research data were collected, further processing and analysis of pre-test, post-test and N-gain data of mathematical problem-solving ability were carried out. The results of testing the N-Gain value to see the difference in improving mathematical problem-solving ability

based on initial mathematical ability (high, medium, and low) in students whose learning is conventional using learning with a contextual approach through anova test one-way ANOVA test, previously it was known that the N-Gain data were normally distributed and homogeneously varied after the normality test and Levene test and homogeneous variance after normality test and Levene test.

One-way ANOVA test results were obtained with a significance value of 0.019, where the value was smaller than $\alpha = 0.05$. is smaller than $\alpha = 0.05$. It means that there is a difference in the improvement of students' mathematical problem-solving ability based on students' initial mathematical ability mathematical abilities. To see the location of the difference in the improvement of students' mathematical problem-solving ability mathematical problem-solving ability of students based on high mathematical initial ability (KAM), medium, and low students by conducting the LSD test because it has fulfilled the normality and homogeneity requirements. Normality and homogeneity requirements, as for the results, show that initial mathematical ability for high and medium categories experienced

It is indicated by a significance value of 0.08, where the significance value is smaller than 0.008. significance value is smaller than $\alpha = 0.05$. Then, the high category with low also experienced an increase in the significance value is 0.023, where the value is smaller than $\alpha = 0.05$. But for the medium KAM category and low did not increase where the significance value was 0.023, where the value is more significant than $\alpha = 0.05$. The results of testing the N-Gain value to see the difference in improving mathematical problem-solving ability based on initial mathematical problem-solving ability (high, medium, and low) in students whose learning using learning with a contextual approach and students who use conventional learning through a two-way ANOVA test using conventional learning through a two-way anova test, previously it was known that the N-Gain data were normally distributed. The variance was not homogeneous after the normality, and two-way anova tests were homogeneous after the normality and Levene tests. We obtained the anova test results with a significance value = 0.000 for learning as the source. Because the significance value is <0.05, H0 is rejected. It shows that there is a difference in the improvement of problem-solving ability that there is a difference in the improvement of mathematical problem-solving ability between students who use learning with a contextualized approach and students who use learning with a contextualized approach and students using conventional learning.

The results of the two-way ANOVA test based on KAM obtained a significance value of 0.000 is more significant than 0.05 or sig.>0.05, which means that there is a significant difference in the mean score of students' communication ability significant increase in the average score of students' communication skills between high, medium and low mathematics ability. To find out the difference in improvement in terms of initial maths ability mathematical ability (KAM) and learning between students whose learning with contextual approach and conventional learning and conventional learning in terms of which high, medium, and low categories are significantly different in mathematical problem-solving ability. Significantly different in mathematical problem-solving ability, the Tamhane test was conducted. The significance value of the High and Medium KAM and High and Low KAM is 0.003, which means that the mathematical problem-solving ability is significantly different. The low is 0.003, which means that the N-gain score of the mathematical problem-solving ability of students in the high category is significantly different. Mathematical problem-solving ability N-gain scores of students in the high category were not significantly different from the N-gain score of the mathematical problem-solving ability of the pair KAM. Medium and High have a significance value of 0.003 but are significantly different from the mathematical problem-solving ability N-gain score of the KAM pair significantly different from the Moderate and Low KAM with a significance value of 0.003.

An essential finding is a significant difference in improving mathematical problem-solving ability between students using a contextual approach and conventional learning. It suggests that the contextual approach, which emphasizes real-world applications of mathematics, has a positive impact on students' problem-solving skills. This result aligns with the notion that providing meaningful and

relevant learning experiences can enhance students' understanding and application of mathematical concepts. The study's focus on initial mathematical ability (KAM) is also noteworthy. The finding that students with high initial mathematical abilities showed the most significant improvement with the contextual approach indicates that this approach effectively caters to the needs of academically advanced students. It suggests challenging and engaging these high-ability students with real-world problem-solving scenarios can further develop their mathematical skills. However, the lack of a significant difference in improvement between students with medium and low initial mathematical abilities in the contextual approach raises some interesting questions. It may indicate the need to adapt the approach to cater to the diverse needs of students with varying levels of mathematical proficiency. Further research could explore modifications or additional strategies to support students with medium and low initial abilities, ensuring they also benefit from the contextual approach.

The two-way ANOVA test's significant results regarding the impact of learning methods and initial mathematical ability on problem-solving improvement further reinforce the importance of considering these factors in mathematics education. It suggests that both the choice of learning approach and students' initial abilities are critical factors in determining the success of mathematics instruction. The findings have practical implications for educators and curriculum designers. Implementing the contextual approach in mathematics classrooms can foster a deeper understanding of mathematical concepts and encourage students to view math as relevant to their lives. Additionally, recognizing the influence of student's initial abilities can guide teachers in tailoring instruction to meet individual needs, promoting equitable learning outcomes. Overall, this study contributes valuable insights into effective mathematics instruction and highlights the significance of context-based learning in enhancing problem-solving skills. Further research could delve into the long-term effects of the contextual approach on students' overall mathematical proficiency and investigate the teaching strategies most effective for different levels of initial mathematical ability. Such efforts will continuously advance the field of mathematics education and improve students' learning experiences.

Conclusion

This study concludes a significant difference in improving mathematical problem-solving skills between students using a contextual approach and those learning using conventional learning. The results of this research support the use of contextual approaches in learning mathematics, especially for students with high initial mathematical abilities. Furthermore, the study significantly improves mathematical problem-solving among students with different initial mathematical abilities (high, medium, and low). The contextual approach provides more significant benefits, especially for students with high initial mathematical abilities. However, the study also highlights the importance of considering other factors that may influence the improvement of mathematical problem-solving abilities, such as teacher-student interactions, the learning environment, and the teaching methods used. Further research could explore the long-term effects of contextualized learning on students' mathematical problem-solving skills and its potential application in different levels of education. Overall, the findings of this study make essential contributions to the development of more effective mathematics curricula and learning strategies, emphasizing the importance of relevant and applicable learning experiences to enhance students' mathematical problem-solving abilities.

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