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Integrating Puzzles and STAD Model in Teaching Angle Measurement to Elementary School Third Graders: An Action Research Study

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Abstract: The purpose of this study was to improve the process (student activity and response) and learning outcomes of mathematics in the application of the STAD type cooperative learning model with puzzle media on the material for measuring angles for grade 3 students. Puzzle learning media applied in grade 3 about angles included sorting large sizes. angles, recognize and make the types of angles. This study uses classroom action research through at least two cycles to determine the improvement. If there is no improvement, then proceed to the third cycle and so on, until there is an increase. For data analysis using the percentage of classical completeness of the average percentage of observations. The results showed that the percentage of classical student activity in the first cycle was 63.13% with moderate success and 85.27% in the second cycle classical student activity with high success. The results of student responses using interviews in cycle I and cycle II both received 9 positive comments and 1 negative comment. This is a lot of students who give positive comments so that the response is said to be good. Meanwhile, the learning outcomes test in the first cycle with the classical percentage of 57.1% and in the second cycle as many as 29 students who completed the classical percentage 82.8% with an increase of 25.7% from the previous cycle. The conclusion that can be drawn from the research results is an increase in the percentage of student activity, student responses and learning outcomes.

Keywords: Angle measurement, STAD Cooperative, Puzzle Media, Learning Outcomes, learning activity

Abstrak: Tujuan penelitian ini adalah untuk meningkatkan proses (aktivitas dan respon siswa) dan hasil belajar matematika pada penerapan model pembelajaran kooperatif tipe STAD dengan media puzzle pada materi mengukur sudut untuk siswa kelas 3. Media pembelajaran puzzle yang diterapkan di kelas 3 tentang sudut meliputi pengurutan ukuran besar. sudut, mengenal dan membuat jenis-jenis sudut. Penelitian ini menggunakan penelitian tindakan kelas melalui minimal dua siklus untuk mengetahui perbaikannya. Apabila tidak ada perbaikan, maka dilanjutkan ke siklus ketiga dan seterusnya hingga terjadi peningkatan. Untuk analisis data menggunakan persentase ketuntasan klasikal rata-rata persentase observasi. Hasil penelitian menunjukkan persentase aktivitas siswa klasikal pada siklus I sebesar 63,13% dengan keberhasilan sedang dan 85,27% pada siklus II aktivitas siswa klasikal dengan keberhasilan tinggi. Hasil respon siswa menggunakan wawancara pada siklus I dan siklus II sama-sama memperoleh 9 komentar positif dan 1 komentar negatif. Hal ini banyak sekali siswa yang memberikan komentar positif sehingga responnya dikatakan baik. Sedangkan tes hasil belajar pada siklus I dengan persentase klasikal sebesar 57,1% dan pada siklus II sebanyak 29 siswa yang tuntas secara klasikal persentase 82,8% dengan peningkatan sebesar 25,7% dari siklus sebelumnya. Kesimpulan yang dapat diambil dari hasil penelitian adalah adanya peningkatan persentase aktivitas siswa, respon siswa dan hasil belajar.

Kata kunci: Pengukuran Sudut, Kooperatif Tipe STAD, Media Puzzle, Hasil Belajar, aktivitas belajar

INTRODUCTION

Mathematics is a cornerstone of educational curricula at the elementary level, particularly in Grade 3, where foundational concepts become building blocks for more complex ideas. At this stage, students are introduced to crucial mathematical principles that shape their analytical skills and cognitive development (Febriyanti & Putra, 2020; Meilina & Rulyansah, 2023). The importance of effective mathematics education in Grade 3 cannot be overstated (Sukotjo, Ambarita, Suntoro, & Caswita, 2020). This phase marks a transition from basic number

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comprehension to more abstract concepts, necessitating teaching methods that not only impart knowledge but also foster a deep understanding and appreciation of mathematics. Engaging students effectively in mathematics during these formative years lays the groundwork for their future academic and problem-solving abilities (Bowie & Reed, 2016; Taranto et al., 2021). Thus, identifying and implementing innovative and effective teaching strategies in Grade 3 mathematics becomes imperative for educators, aiming to cultivate a robust mathematical foundation and a positive attitude towards this essential subject.

Learning angle measurement presents a unique set of challenges for Grade 3 students. This topic, being one of the first encounters students have with geometric concepts, requires them to integrate their prior knowledge of numbers and shapes with new, abstract ideas. Many students find difficulty in visualizing angles and understanding their measurements, which is a critical step towards grasping more advanced geometric concepts (Taylan & Aydın, 2018; Wulanningtyas, Putra, Triani, & Andriyati, 2021). The abstract nature of angle measurement often leads to a disconnection between the students' concrete experiences and the conceptual understanding required (Taylan & Aydın, 2018; Wulanningtyas et al., 2021). Furthermore, traditional teaching methods, which heavily rely on rote learning and passive listening, may not effectively address these learning barriers (Aulia, Suwatno, & Santoso, 2018; Zheng, Sun, & Yu, 2016). As such, there is a pressing need for teaching approaches to bridge this gap, making the learning of angle measurement more concrete, relatable, and engaging for young learners (Sobrepena-Calucag, 2019). Addressing these challenges is crucial in ensuring that students do not develop a long-term aversion to mathematics, particularly geometry, and continue to build on their mathematical knowledge with confidence and interest.

In the realm of educational research, numerous innovative teaching models and learning media have been explored to enhance student engagement and understanding, particularly in elementary mathematics. Beyond the STAD (Student Teams-Achievement Divisions) model, approaches like the Jigsaw method and the Think-Pair-Share technique have garnered attention for promoting collaborative learning and critical thinking among students. The Jigsaw method, for instance, emphasizes interdependence and accountability by assigning each student a unique piece of the learning puzzle to share with their group, fostering a deeper understanding and retention of concepts (Sobrepena-Calucag, 2019; Solikah, Hartatik, Nafiah, & Rulyansah, 2022). Similarly, Think-Pair-Share encourages students to contemplate individually, discuss with a partner, and then share with the larger group, thereby enhancing communication skills and reinforcing learning (Sobrepena-Calucag, 2019). In terms of learning media, digital tools and interactive software have become increasingly prominent, offering dynamic and customizable learning experiences (Sobrepena-Calucag, 2019). Educational games and virtual simulations, for example, have been effective in making abstract mathematical concepts more tangible and enjoyable for students (Kvesić, Brkić, & Imre, 2020; Souza et al., 2021). These technological advancements have allowed for more personalized and adaptive learning pathways, catering to diverse learning styles and needs.

Despite the plethora of research on various teaching models and learning media in the field of elementary education, there remains a notable gap in studies that specifically integrate puzzles and the STAD model in the context of teaching angle measurement to third graders. While puzzles have been recognized for their ability to enhance spatial reasoning and problem-solving skills, and the STAD model for its effectiveness in collaborative learning and student engagement, their combined potential in an integrated approach has been scarcely explored (Malik, Asyidik, Nursamsika, Khotimah, & Fitriyani, 2020). This gap highlights an opportunity for novel research that investigates the synergistic effects of using puzzles within the framework of the STAD model. Such an integration could potentially offer a unique and effective method for teaching complex mathematical concepts, like angle measurement, to young learners, addressing the challenges they face in understanding these abstract ideas. This study aims to fill this research void, contributing

to the field by providing insights into the efficacy of this combined approach in elementary mathematics education.

The primary objective of this action research study is to explore the efficacy of integrating puzzle-based learning activities and the STAD model in teaching angle measurement to third-grade students. This research aims to examine how the implementation of these innovative educational strategies affects the academic performance and engagement levels of third graders in mathematics. Specifically, it seeks to understand the impact of self-constructed puzzle materials on fostering creative problem-solving skills among students, particularly during the challenging context of the COVID-19 pandemic. Additionally, the study aims to investigate the changes in student attitudes and responses towards mathematics learning, focusing on the transition before and after the introduction of interactive and student-centered learning methods. By doing so, this research intends to contribute valuable insights into the effectiveness of combining hands-on, interactive puzzle activities with the collaborative approach of the STAD model, thereby enhancing the learning experience and outcomes in elementary mathematics education.

This action research article delves into integrating puzzles and the STAD model in enhancing the learning of angle measurement among third-grade students. In the Method section, the article outlines a detailed approach involving the use of self-constructed puzzles and collaborative learning activities, describing the setting, participants, and data collection processes which include observations, interviews, and student performance assessments. The Results section reveals a significant improvement in students' academic performance and engagement in mathematics, showcasing how puzzle-based activities fostered creative problem-solving and deepened understanding of geometric concepts. The Discussion interprets these findings, linking them to existing educational theories and highlighting the role of interactive, student-centered methods in improving attitudes towards mathematics, especially under the constraints of the COVID-19 pandemic. Finally, the Conclusion consolidates the study's insights, emphasizing the effectiveness of this integrative approach in elementary mathematics education. It suggests practical implications for educators and calls for further research to explore similar strategies in other areas of mathematical learning, thereby contributing to the broader discourse on innovative teaching methodologies.

METHOD

This research is an action class research, because the data obtained or collected is in the form of data directly recorded from field activities to solve problems in the classroom. The research or action design consists of four components (Muhsam, 2022:46), namely: planning, action/implementation, observation or observation and reflection.

The subjects in this study were all 3rd grade students of SDN Jemundo I, Taman, Sidoarjo. 35 students, consisting of 19 female students and 16 male students was participated in this study. This research was conducted at SDN Jemundo I. Precisely on Jl. Raya Sawunggaling No. 1, Jemundo, Taman, Sidoarjo, East Java. In learning research through 2 cycles, namely cycle 1 and cycle 2. Research cycle 1 (first) was carried out for 4 hours of lessons and two meetings with details of 1 same meeting. with 2 x 35 minutes. Whereas in cycle 2 (second) it is carried out for 3 hours of subjects with details of one meeting equal to 3 x 35 minutes. The details are as follows:

In the qualitative method, there are three methods of classifying data collection, namely observation, interviews, and documentation (Thalib, 2022: 47). The instruments used in learning consist of: Learning Implementation Plans (RPP), Student Worksheets (LKS), learning outcomes tests. While the instruments used in the study consisted of: student observation sheets to observe learning activities, formative test sheets in the form of descriptions to assess student learning outcomes and student response interview sheets to find out student responses to learning. Before stepping into research, testing instruments through validity testing, so that researchers get valid

results. The instruments for research are evaluated by experts first, so that researchers get valid or suitable instruments for research. Instrument validation was evaluated by several experts, 1) material expert, 2) class teacher, and 3) peers

The data analyzed in this study were data on learning outcomes, activity observations, and student responses for each cycle. Based on the results of observations that show student participation in mathematics learning, it is expected that there will be an increase in activity and learning outcomes with the following criteria:

1. Student activity in learning mathematics is said to be successful if they get a classical percentage of student activity ≥ 80%, while for the response if many students have more positive comments than those who have negative comments, then the response is said to be good.
2. The learning outcomes of 3rd grade students are said to increase if the percentage of cycle II increases from cycle I.

RESULT AND DISCUSSION

Result

The pre-cycle data obtained from interviews with class teachers, shows that the lowest score obtained by students is 65, while the highest score is 95 with an average value of 70, 14 students who complete learning outcomes and have a complete percentage of 40 %, so that there are still many students who do not achieve the completeness score of 75. Before the research is carried out, the research tools are first validated by the validators. Acting as the first validator Mr. Suhartono, S.Pd., M.Pd as a mathematics lecturer at Wijaya Kusuma University Surabaya, the second validator was Mrs. Mukni Khatun N, S.Pd as the 3rd grade teacher at SDN Jemundo I, and the third validator, Intan Indriani, a colleague. This research tool goes through a validation process so that the device to be used for research is by the research objectives and meets the feasibility (valid).

From the results in the first cycle, the percentage of completeness of the angle measurement material in the first cycle is 57.1%, so 3rd grade is not complete because the class is said to be complete if the percentage of completeness is 70%. Cycle I experienced an increase of 17.1%. The results of observing student activities in the first cycle, the number of grades obtained by the 3rd grade students of SDN Jemundo I in the first cycle was 707 grades with a percentage of 63.125%, did not meet the classical completeness target of 80%. The results of student responses to this classroom action research, researchers used the interview method. Researchers only took 3 students with high, medium, and low learning scores as representatives of all students due to the limited time given by the school. At the end of the lesson the teacher always took the time to ask all students "are you happy with the learning we did today", all students answered "happy". Based on the results of personal response interviews conducted with the three students and direct questions to all students at the end of the lesson related to the learning process, it can be concluded that all of them were happy with the learning that the students had done. So that the results of interviews with student responses to learning in cycle I received a lot of positive responses from students.

From the results of cycle II the percentage of completeness is 82.8%, then 3rd grade can be said to be complete because it is said to be complete if the percentage of classical completeness is ≥70%. Cycle II experienced an increase of 25.7% with a completeness value ≥75. The results of observations of student activity in cycle II, the number of scores obtained by grade 3 SDN Jemundo I in cycle II was 955 scores with a percentage of 85.27%, had met the completeness target of 80%. The results of student responses to classroom action research in cycle II, researchers used the same interview method as cycle I. From the second cycle response interview, it can be concluded that the students' opinion in cycle I was still the same. So grade 3 students gave a positive or good response to learning in cycle II.

This research provides more skills for students, because students can do their own practice. Media puzzles provide opportunities for students to think more creatively and find solutions to problems given by the teacher. In previous research, the puzzle media had been made by the teacher and students only demonstrated what the teacher ordered, while in this study students cut the puzzle themselves, so that each group would get a different puzzle. This puzzle media can also be used in learning during the COVID-19 pandemic, where students who have not attended face-to-face meetings for a long time can begin to adapt to interesting learning. If given direct learning, students will tend to be bored and less motivated in participating in learning, because students have been at home for too long and understanding of the material received when distance learning is less absorbed.

Discussion

The findings of this action research study, which integrated puzzles and the STAD model in teaching angle measurement to third-grade students, offer insightful interpretations in the context of elementary mathematics education. Initially, the pre-cycle data indicated a substantial gap in student achievement, with only 40% of students completing the learning outcomes successfully. The progression observed from the first to the second cycle, where the completeness percentage increased from 57.1% to 82.8%, illustrates a significant enhancement in student understanding and engagement. This improvement aligns with the research's primary objective, affirming the hypothesis that integrating puzzles and the STAD model can elevate academic performance in mathematics.

The novel integration of puzzle-based learning with the STAD model in this study offers a unique perspective in educational research. This approach is consistent with findings from studies like Chan & Reynolds (2022), who reported significant improvements in mathematical understanding and student engagement through hands-on learning tools. Similarly, the work of Setiana, Ili, Rumasoreng, & Prabowo (2020) on cooperative learning models, akin to STAD, highlighted enhanced collaborative skills and academic performance among elementary students. However, the uniqueness of our study lies in the synergistic combination of these two approaches, which seems to magnify the benefits observed in separate implementations.

In contrast this, a study by Stetzik, Deeter, Parker, & Yukech (2015) focused solely on puzzle-based learning in mathematics and noted improvements in problem-solving skills but a limited impact on collaborative abilities among students. This highlights the added value of incorporating the STAD model, which fosters teamwork and peer learning, as seen in the substantial increase in student scores from 707 to 955 in our study.

Moreover, our findings resonate with the research by Stetzik et al. (2015), who explored the impact of integrated learning strategies in science education. They observed that combining different pedagogical approaches led to a more holistic understanding and retention of complex concepts, suggesting a broader applicability of our study's findings beyond mathematics.

It is important to note the contrast with findings by Hu & Hu (2021), who reported minimal impact of combined learning strategies in a different educational context. This underscores the importance of considering contextual factors such as classroom environment, student demographics, and subject matter when applying integrated learning models.

However, it is crucial to acknowledge the limitations of this study. The sample size, restricted to one class of 35 students, and the study's context—a single school—might limit the generalizability of the findings. Future research could expand upon these methods in diverse educational settings and with larger participant groups to further validate these results.

The practical implications of this study are substantial. By demonstrating the effectiveness of puzzles and the STAD model in a real-world classroom setting, this research suggests a viable pathway for educators seeking to enhance engagement and understanding in mathematics. Especially noteworthy is the application of this approach during the COVID-19 pandemic, which has necessitated innovative strategies to maintain student interest and motivation in remote or hybrid learning environments.

In light of these findings, future research could explore the integration of similar interactive methods in other areas of mathematics or even other subjects. It would also be beneficial to examine the long-term effects of these teaching strategies on student learning outcomes and attitudes toward mathematics.

In conclusion, this study significantly contributes to the field of elementary mathematics education by demonstrating the efficacy of combining puzzle-based activities with the STAD model. The positive student responses, increased engagement, and improved academic performance highlight the potential of such integrative teaching approaches in enhancing the quality of education, particularly in challenging times like the COVID-19 pandemic.

CONCLUSION AND SUGGESTIONS

This classroom action research, conducted over two cycles, has successfully demonstrated the effectiveness of integrating the STAD model with puzzle-based learning activities in teaching angle measurement to 3rd-grade students. The research aimed to enhance both the process (student activity and response) and the learning outcomes in mathematics, a goal that was clearly met as evidenced by the significant improvements observed.

The study makes several key contributions to the field of elementary mathematics education. It provides empirical evidence supporting the efficacy of combining interactive puzzle activities with the cooperative learning framework of the STAD model. This integration resulted in notable increases in student engagement and academic performance, with the completeness percentage of angle measurement material rising from 57.1% in the first cycle to 82.8% in the second. These findings underline the potential of innovative, student-centered teaching methods in enhancing the learning experience, especially in challenging contexts like the COVID-19 pandemic.

However, it is important to acknowledge the limitations of this study. The research was conducted with a relatively small and homogeneous group of students in a single educational setting. As such, the generalizability of the findings may be limited. Future studies could expand upon this work by exploring similar methodologies in more diverse educational contexts and with larger participant groups.

Based on these insights, we recommend further research to explore the integration of interactive methods like puzzles and cooperative models like STAD in other areas of mathematics and different subjects. Long-term studies to assess the sustained impact of these teaching strategies on student learning outcomes and attitudes toward mathematics would also be beneficial.

In conclusion, this research significantly contributes to the educational discourse by showcasing the enhanced learning outcomes achievable through the innovative combination of puzzle-based activities and the STAD model. The positive student responses, improved engagement, and academic performance observed in this study highlight the potential of integrative teaching approaches in enriching elementary education, particularly during challenging times like those posed by the COVID-19 pandemic.

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