Improving mathematics interest and achievement through contextual teaching and learning

Deny Hadi Siswanto[a,1*], Andriyani[a,2], Muhammad Yusuf Rambe[b,3]

[a] Department of Master's in Mathematics Education, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Yogyakarta, Indonesia
[b] Department of Fiqh Wa Usul, Faculty of Syariah wal Qonum, Al-Wasathiyah University, Hadramaut, Yemen
[1] 2207050007@webmail.uad.ac.id*; [2] andriyani@mpmat.uad.ac.id; [3] yusuframbe26@gmail.com
* corresponding author

ARTICLE INFO

Article history
Received: May 9, 2024
Revised: April 1, 2025
Accepted: May 1, 2025

Keywords
Interest to learn
Mathematics
Learning outcomes
Contextual teaching and learning

ABSTRACT

This study is a Classroom Action Research (CAR) aimed at improving students' interest in learning mathematics through the implementation of the Contextual Teaching and Learning (CTL) model. The research subjects were 30 students from class XI Natural Science at Muhammadiyah Mlati High School (SMA Muhammadiyah Mlati) during the even semester of the 2023/2024 academic year. The study was conducted in two cycles, each consisting of the stages of planning, action implementation, observation, and reflection. Data collection was carried out through observations, interest in learning questionnaires, and learning outcome tests. The study's results showed a significant improvement in students' interest in learning. The average score for students' interest in learning increased from 1.76 (very low category) in the initial stage to 2.42 (low category) in cycle I, and reached 3.62 (very high category) in cycle II. In addition, students' learning outcomes also showed a remarkable improvement, with the average initial score rising from 34.4 to 56.1 in cycle I, and reaching 74.1 in cycle II, indicating that most students had met the Minimum Completeness Criteria. The results of this study imply that the application of the CTL model can be an effective strategy to increase students' interest and learning outcomes in mathematics, while also providing a basis for teachers, schools, and policy makers in developing more meaningful and contextual learning.

1. Introduction

Mathematics is an important subject in the field of education because it serves as the foundation for mastering knowledge and technology (Wantoro et al., 2025). However, the reality in the field shows that most students struggle to understand mathematical concepts, including matrix material. This has led to low student interest and learning outcomes, particularly in high school. Many students perceive mathematics as a difficult and boring subject because it is presented in an abstract and non-contextual way. If this situation is left unchecked, it will hinder the learning process and the achievement of student competencies. Therefore, a teaching strategy is needed that can connect mathematical material with the real-life context of students (Aprilia et al., 2025).

Student interest is one of the key factors influencing success in learning mathematics (Putri et al., 2025). Students with high interest are more active in participating in the learning process and can better understand the material being taught. On the other hand, students with low interest tend to be passive and easily lose concentration (Kamid et al., 2022). In this context, teachers play a vital role in creating an engaging and relevant learning atmosphere for students. A pleasant learning environment can stimulate students' internal motivation to absorb knowledge. One model that is believed to enhance

student interest in learning is Contextual Teaching and Learning (CTL) (Johnson & Christensen, 2014).

Contextual Teaching and Learning (CTL) is a learning model that connects the lesson material with students' real-world situations, making learning more meaningful (Welerubun et al., 2022). CTL encourages students to build their knowledge through direct experiences, collaboration, and reflection (Fitriana et al., 2025). Through this approach, students not only understand mathematical concepts theoretically but also learn to apply them in their daily lives. CTL also helps students establish connections between the knowledge they gain in school and its real-world applications. As a result, the learning process becomes more active, interactive, and personal. This model can be a solution for improving both student interest and learning outcomes in mathematics (Lestari et al., 2021).

Matrix material is often considered difficult by students because it is abstract and requires logical thinking and operational skills (Apriliya & Basir, 2020). In practice, many students experience confusion when performing matrix operations such as addition, subtraction, and multiplication. This difficulty is compounded by the presentation of material that lacks context, preventing students from understanding its practical benefits. In fact, matrix concepts are highly relevant in various fields such as information technology, economics, and engineering (Kurniawan et al., 2021). Students' ignorance of the real-world applications of matrices makes the learning process feel meaningless. Therefore, it is necessary to apply a teaching method that bridges the understanding of concepts with the students' real-world experiences (Kintoko & Siswanto, 2024).

The implementation of CTL in teaching matrices is expected to address the issues of low student interest and learning outcomes (Hayati et al., 2022). Through the CTL strategy, teachers can present matrix material in the form of contextual problems, such as data processing or basic financial management. Students are encouraged to explore, discuss, and solve problems in groups, making the learning process active and meaningful. This not only improves conceptual understanding but also develops critical thinking and teamwork skills. Such learning approaches allow students to engage directly and perceive that the material they are learning has real-world benefits. Therefore, the application of CTL is highly relevant for improving the quality of mathematics education.

SMA Muhammadiyah Mlati, as an educational institution, is committed to improving the quality of learning through innovative teaching strategies. Based on initial observations, it was found that student interest and learning outcomes in mathematics, particularly in matrix material, were still relatively low. Some students expressed that they found the material difficult to understand because they could not relate it to real-life situations. This lack of understanding and learning motivation poses a challenge that needs to be addressed immediately (Yogyanto et al., 2024). This situation highlights the need for the implementation of more relevant and engaging teaching strategies. One alternative is the application of the CTL model, which has been proven effective in improving learning outcomes in various contexts (Siswanto et al., 2024)

Based on the above explanation, this research aims to examine and implement the Contextual Teaching and Learning model to improve student interest and learning outcomes in matrix material in class XI Natural Science at SMA Muhammadiyah Mlati. This study is expected to contribute to the development of innovative, effective, and contextual teaching strategies. Furthermore, the findings of this study can serve as a reference for mathematics teachers in designing lessons that bridge theory and practice. With the improvement in student interest and learning outcomes, it is hoped that students' understanding of mathematical concepts will be stronger and more applicable.

2. Method

2.1. Research design

This research employs a Classroom Action Research (CAR) design, which is a systematic inquiry conducted collaboratively within the classroom setting to improve teaching and learning practices. The study is carried out through four interconnected stages: planning, implementation of actions, observation, and reflection. These stages are carried out in a cyclic manner, allowing continuous refinement of the teaching strategies and learning activities based on the findings of each cycle. The primary objective of this CAR is to enhance students' interest in learning mathematics by implementing instructional interventions that are continuously evaluated and improved throughout the research process. To guide the implementation, this study adopts the CAR cycle model developed by

Arikunto (2017), which provides a structured framework for designing, executing, monitoring, and reflecting upon classroom interventions. The procedural flow of this cycle is illustrated in Figure 1.

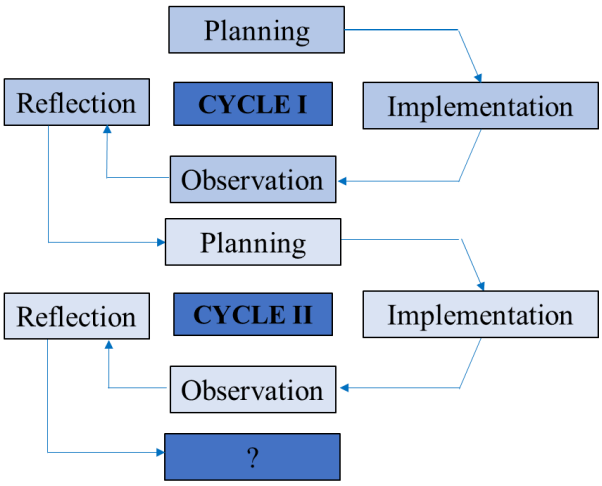

Fig. 1. Classroom action research cycle

2.2. Participants of the research

The research was conducted from January to April 2024 at SMA Muhammadiyah Mlati. This school is located on Magelang Street km 7, Sleman Regency. The subjects of this study were 30 students from class XI Natural Science in the 2023/2024 academic year, consisting of 22 male students and 8 female students.

2.3. Data collection tools

The data in this research were collected using multiple techniques to ensure the validity and comprehensiveness of the findings. Direct observation of classroom activities was conducted to capture students' behaviors, participation, and responses during the learning process. In addition, questionnaires were distributed to measure students' interest in learning mathematics, while tests were administered to evaluate their academic achievement and overall learning outcomes.

2.4. Research procedure

This research followed the Classroom Action Research cycle, which includes the stages of planning, implementation, observation, and reflection. If optimal results have not been achieved in Cycle I, particularly in terms of improving students' interest in learning mathematics, the research will continue to Cycle II. The cycle process will be stopped when the learning activities have successfully increased students' interest in learning and when the class-wide learning outcomes are deemed sufficient.

2.5. Data analysis technique

The data analysis technique used in this research involved systematically processing and interpreting the results obtained from observations, questionnaires, and tests administered during the learning process. The data were analyzed to identify patterns, trends, and changes that indicated an improvement in students' interest in learning mathematics over the course of the research cycles. Furthermore, the analysis was aimed at evaluating the effectiveness of the implemented instructional actions, thereby providing evidence of whether the applied strategies successfully enhanced both students' engagement and overall classroom learning outcomes.

3. Results and Discussion

This study was conducted at Muhammadiyah Mlati High School located at Jalan Magelang km 7 Sleman. The research subjects consist of 30 students from the XI Natural Science class in the second semester of the 2023/2024 academic year. In the initial stage, the results of the students' questionnaire on their interest in learning mathematics yielded an average score of 1.76, categorized

as very low. This preliminary finding served as the foundation for determining the need for classroom action research interventions. The data can be seen in the following Figure 2.

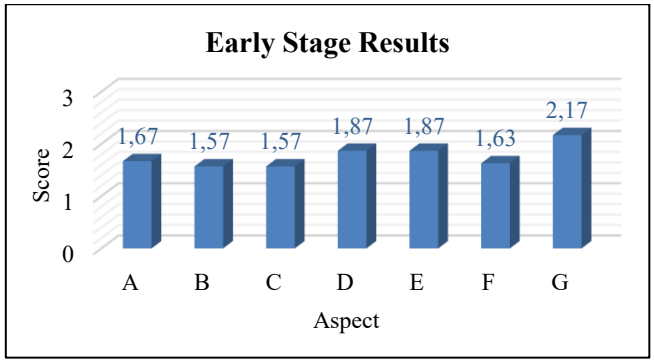

Fig. 2. Early stage results

Based on the observations of the students' interest in learning, data was obtained with varying scores for each indicator. The aspect of enthusiasm in participating in learning (A) received a score of 1.67, while the enthusiasm for completing assignments (B) and the habit of taking notes on important points from the teacher's explanation (C) each received a score of 1.57. The activities of asking questions and expressing opinions during the lesson (D) and efforts to collect solutions to problems (E) both received the highest score of 1.87. However, the ability to listen and focus when the teacher provides an explanation (F) only earned a score of 1.63. The aspect of enthusiasm towards learning activities in general (G) received the highest score of 2.17. Overall, the total score for students' interest in learning was 12.33 with an average of 1.76, which falls into the very low category, indicating the need for an intervention with more effective and engaging teaching strategies to improve students' interest in learning.

The description of cycle I consists of two main stages, namely the planning stage and the implementation stage. The steps in the planning stage involve several essential actions. The first step is to develop a lesson plan using the CTL model. Following that, prepare the learning materials to be delivered during the lesson. Next, prepare observation sheets to monitor students' interest in learning throughout the teaching process. Lastly, prepare the first cycle test questions in the form of descriptive questions, which will be an integral part of evaluating the teaching process. With these steps, lesson planning can be conducted comprehensively and effectively (Muslimin, 2023).

In this implementation phase, two learning sessions were conducted, each lasting 2x45 minutes. The researcher directly acted as the teacher in the class and applied the Contextual Teaching and Learning (CTL) model. In the first session, all 30 students were present and actively participated in the learning activities. The teacher began the lesson by greeting the students, leading a prayer, and taking attendance. The teacher then directed the students to work in groups, introduced the concept of contextual learning, and encouraged all students to actively engage in the learning process.

During the core activity, the teacher provided a brief explanation about algebraic expressions and asked questions to relate the material to everyday life. Students were then assigned the task of analyzing word problems and given the opportunity to ask questions if anything was unclear. The teacher distributed practice problems from the student book for group discussion. Each group selected a representative to present their discussion results in front of the class and explain their understanding. The teacher guided the students in summarizing the group's discussion outcomes and reinforced their understanding of the material they had learned.

The second session also lasted for 2x45 minutes, with full attendance of the students. The activity began with greetings, a prayer, and attendance taken by the teacher. Students were directed to sit according to their groups, and the teacher reviewed the previous material with some introductory questions. The material discussed focused on classifying algebraic expressions based on their terms. After understanding the example problems from the book, students were given a worksheet for cycle I and asked to complete it independently. At the end of the session, the teacher distributed an evaluation questionnaire, discussed the students' work results together, provided information about the next topic, closed with a prayer, and gave a closing greeting. Table 1 describes the results of cycle I.

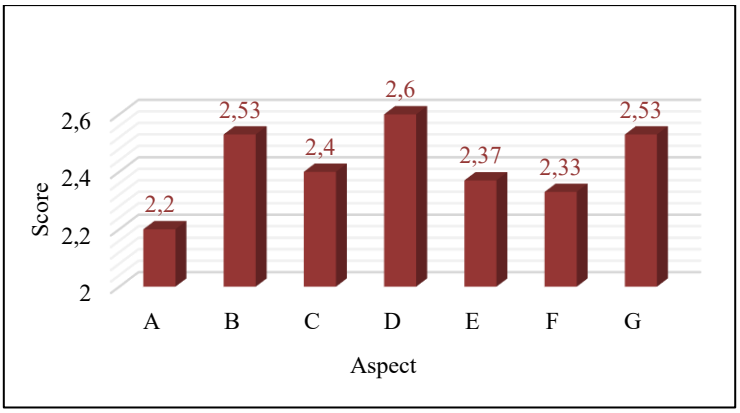

Fig. 3. Cycle I results

Based on the observation results of the aspects of student interest in learning at the initial stage after the implementation of the learning process, the data shows scores that indicate an improvement compared to the previous condition, although still categorized as low. Students demonstrated enthusiasm in participating in the learning process (A) with a score of 2.20, and commitment to completing tasks (B) achieved a score of 2.53. The habit of taking important notes from the teacher's explanation (C) reached a score of 2.40, while the activity of asking questions and expressing opinions during learning (D) received the highest score of 2.60. Effort in gathering solutions to solve problems (E) received a score of 2.37, the ability to listen and focus while the teacher explained (F) scored 2.33, and overall enthusiasm for the learning activities (G) recorded a score of 2.53. From all aspects, the total score obtained was 16.97, with an average score of 2.42, indicating that student interest in learning is in the low category, but showing an improvement from the very low condition previously.

After reflecting on the results of Cycle I, corrective actions have been taken to address the deficiencies that occurred during the learning process in that cycle. These actions are designed to improve the effectiveness of the teaching strategies and to enhance student engagement in the classroom. In Cycle II, the implementation of these corrective actions is carried out systematically to ensure that the learning objectives can be achieved more optimally.

In Cycle II, the first step in the planning stage is to develop the Lesson Plan while considering improvements based on the issues identified in the previous cycle. The main focus is on enhancing the aspects that influence student interest and learning effectiveness. The teaching material to be used is also specifically prepared with a contextual learning approach. The selection of material is made by considering the relevance to the students' life contexts, as well as teaching methods that can encourage in-depth and interactive understanding. Additionally, a student activity observation sheet is prepared as a tool to record and monitor student engagement during the learning process.

The observation sheet will be used to collect data on student activities and their interest in following the lessons, providing valuable input to evaluate the effectiveness of the applied approach. The information gathered from these observations will be used to identify the strengths and weaknesses of the ongoing lesson. Furthermore, a test for evaluation in Cycle II is also prepared in the form of an essay test. This test is designed to measure the extent to which students understand the material and their ability to explain concepts or processes in detail and clearly. Therefore, the results of this test are expected to provide a comprehensive picture of student learning achievements after improvements are made in the Cycle II.

In this implementation stage, two sessions with the CTL model are conducted, each lasting 2x45 minutes. The implementation stage activities in the second cycle are improvements from the first cycle. Improvements in the implementation phase of the second cycle focused on aspects that were still less than optimal in the first cycle, such as increasing the variety of CTL-based learning methods to be more contextual to students' real-life experiences, providing more equal opportunities for discussion so that every student can actively participate, and emphasizing the use of more interactive learning media. Furthermore, teachers also improved the way they provide instructions to be clearer and more systematic, so that students do not experience confusion in participating in learning activities. With these improvements, it is hoped that student engagement in learning will increase and learning objectives can be achieved more effectively.

The researcher conducts observations from the beginning to the end of the implementation of actions using the CTL model. In the implementation of Cycle II, there is an improvement that can be seen from the observation sheet of students' interest in learning as follows. The results of the second cycle activities are described in Table 3.

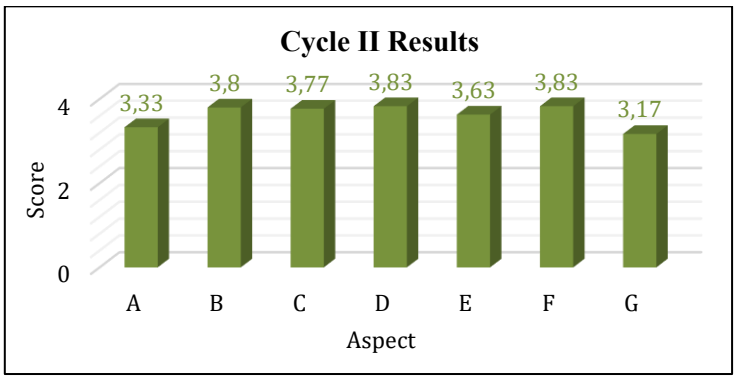

Fig. 4. Cycle II results

Based on the results of the observations regarding the aspects of student interest in learning at the final stage after the implementation of the learning model, the data shows significant improvement. Student enthusiasm in following the lessons (A) scored 3.33, while diligence in completing tasks (B) recorded a high score of 3.80. The habit of noting important points from the teacher's explanation (C) was also relatively high with a score of 3.77, and the activeness in asking questions and expressing opinions during the learning process (D) reached the highest score of 3.83. Efforts in gathering solutions to solve problems (E) earned a score of 3.63, followed by the ability to listen and focus when the teacher explains (F), which also scored 3.83. Although enthusiasm for the learning activities in general (G) was slightly lower compared to other aspects, scoring 3.17, the overall total score achieved was 25.37 with an average of 3.62. This score indicates that student interest in learning is in the very high category, reflecting the success of the applied learning approach in enhancing student engagement and motivation in learning. The observation results from the initial stage, the first stage, and the second stage can be seen in the illustration presented in Table 5.

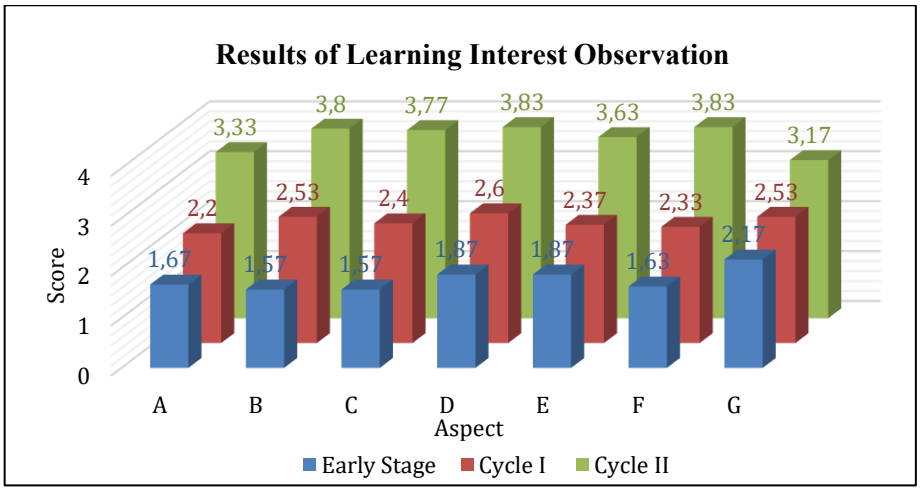

Fig. 5. The observation results and students' learning interest

Based on Figure 4 above, there is a significant improvement in each aspect of student learning behavior from the initial stage to Cycle I, and from Cycle I to Cycle II. The aspect of "enthusiasm in participating in learning" increased by 0.53 from the initial stage to Cycle I, and increased again by 1.13 in the next cycle. The aspect of "working hard in completing tasks" showed an improvement of 0.96 in Cycle I and 1.27 in Cycle II, reflecting an increasing commitment from students toward their tasks. Likewise, the ability to note key points from the teacher's explanation gradually increased by 0.83, and then by 1.37. In the aspect of courage to ask questions and express opinions, there was an

increase from 0.73 to 1.23, indicating that students became more verbally active during the learning process.

A significant improvement was also seen in the aspect of gathering solutions to problems, with an increase from 0.50 to 1.26, and the ability to listen and focus when the teacher explained, which increased from 0.70 to 1.50, marking one of the highest improvements in this table. Meanwhile, enthusiasm for learning activities showed the smallest improvement but remained positive, increasing by 0.36 from the initial stage to Cycle I, and by 0.64 in Cycle II. Overall, this data shows a trend of improvement in students' positive behaviors in learning after actions were taken in two cycles, indicating that the applied learning strategy was effective in increasing student engagement and performance. The individual student scores are presented in Figure 6.

Based on Figure 6, there is a significant improvement in student learning outcomes. In the initial stage, the highest score obtained by a student was 48 (by student S13), the lowest score was 17 (by student S27), and the average student score was 34.4. This indicates that, at the initial stage, most students were still below the completion criteria. In Cycle I, there was an increase in scores, with the maximum score reaching 76 (by student S13), the minimum score being 28 (by student S27), and the average student score rising to approximately 56.1. This increase shows a positive impact from the interventions carried out in Cycle I. In Cycle II, the improvement in student scores became even more evident. The maximum score increased to 88, achieved by students S10, S13, and S15, while the minimum score also improved to 56, obtained by students S24 and S29. The average score in Cycle II was recorded at 74.1. This indicates that most students have reached or even surpassed the learning completion criteria, signaling the effectiveness of the teaching strategy applied during the two cycles.

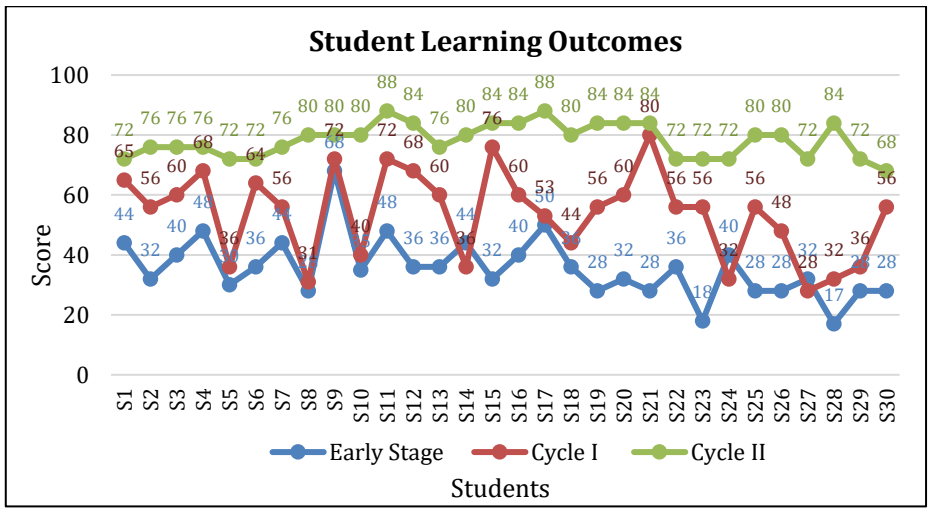

Fig. 6. Student learning outcomes

Based on the research conducted at SMA Muhammadiyah Mlati, it was found that students' interest in learning mathematics at the initial stage was classified as very low, with an average score of only 1.76. This condition was evident from the lack of student enthusiasm in attending lessons, which reflects discomfort or disinterest in the material being delivered. Additionally, the effort put into completing assignments was minimal, indicating that students lacked intrinsic motivation to fulfill their academic responsibilities. Active participation in learning activities was also barely visible, both in discussions and in responding to the teacher's questions. These findings align with Hanama et al. (2024) and Siswanto (2025), who stated that a low interest in learning is one of the main factors contributing to students' poor academic performance in mathematics.

The implementation of the Contextual Teaching and Learning (CTL) model in Cycle I showed an improvement in students' learning interest, rising to the low category with an average score of 2.42. Although this improvement was not yet significant, it gave hope that this learning strategy began to have a positive impact on student attitudes. The CTL model allows students to connect the learning material with real-life experiences, making learning feel more relevant and meaningful. This is supported by the findings of Millah & Wildani (2023) and Syah et al. (2024), who stated that contextual learning can enhance student engagement because the material feels more

relatable to daily life. However, the implementation of CTL must continue to be refined to better suit the needs, characteristics, and learning styles of the students in the classroom.

In Cycle II, after improvements were made based on reflections from the previous cycle, the average student interest score increased significantly to 3.62, falling into the very high category. This increase was clearly visible in students' increased willingness to ask questions, indicating that they began to feel comfortable and motivated to understand the material more deeply. Furthermore, perseverance in completing assignments also increased significantly, reflecting a change in students' attitudes toward their academic responsibilities. Students' ability to stay focused while the teacher explained the material also showed positive development, indicating improved concentration and learning interest (Kintoko et al., 2025; Wahyuni et al., 2024). These results support the research of Afni & Hartono (2020) and Efendi et al. (2025), who found that a well-executed contextual learning model that actively involves students can enhance intrinsic motivation and overall interest in learning.

In addition to increasing learning interest, this study also showed a significant improvement in students' academic performance across each cycle. The average student score, which was initially 34.4, increased to 56.1 in Cycle I and continued to rise encouragingly in Cycle II. This improvement reinforces the assumption that learning interest is strongly and significantly correlated with students' academic achievement in the classroom. Safitri et al. (2023) and Astiwi et al. (2024) explains that interest is one of the key factors influencing the learning process and students' overall academic outcomes. When students feel interested and motivated by the material, they are more likely to understand the information and demonstrate enthusiasm in facing learning challenges.

Overall, this study proves that the CTL approach is effective in enhancing both interest and learning outcomes in high school mathematics, especially through the presentation of relevant and meaningful material. These results also reinforce the findings of Sinaga et al. (2023), who concluded that contextual learning can be an alternative solution to low student engagement. The teacher's role is crucial in designing learning strategies that not only deliver content but also address students' psychological and motivational aspects (Apriwulan et al., 2025; Tarso et al., 2025). Therefore, ongoing professional development for teachers in understanding, designing, and implementing the CTL model effectively should be pursued through training and collaboration. These efforts are an important part of a strategic move toward improving education quality in a sustainable and student-centered manner.

4. Conclusion

Based on the results of the classroom action research conducted in two cycles at SMA Muhammadiyah Mlati, it was found that students' interest in learning mathematics was initially very low, with an average score of only 1.76. This was reflected in the lack of enthusiasm, minimal effort in completing assignments, and low active participation in learning activities. However, following the implementation of the Contextual Teaching and Learning (CTL) model, students' learning interest gradually increased rising to 2.42 in Cycle I (low category) and significantly improving to 3.62 in Cycle II (very high category). Students' academic achievement also showed a notable improvement, with the average score increasing from 34.4 at the initial stage to 56.1 in Cycle I, and reaching 74.1 in Cycle II. This indicates that the majority of students met the Minimum Mastery Criteria after the contextual learning strategy was applied. This improvement was influenced by a learning approach that connected mathematical material to students' real-life contexts and involved group work, active discussions, and collective reflection. For future research, it is recommended to expand the study's subjects and locations to enhance the generalizability of the results, as well as to explore psychological and social aspects that influence learning interest, such as intrinsic motivation, peer support, and student-teacher relationships.

Acknowledgment

We express our gratitude to the Master's Program in Mathematics Education at Ahmad Dahlan University for providing both moral and material support until the publication of this scientific article.

Declarations

Autor contribution : The first author contributed to data collection and drafting the article. The second author contributed as the supervising lecturer who guided the research process.
Funding statement : There is no information available regarding funding for this report.
Conflict of interest : The authors declare that there are no conflicts of interest regarding the publication of this manuscript.
Additional information : Understood, there is no additional information available for this paper.

References

Afni, N. (2020). Contextual teaching and learning (CTL) as a strategy to improve students mathematical literacy. *Journal of Physics: Conference Series, 1581*(1), 012043. https://doi.org/10.1088/1742-6596/1581/1/012043

Aprilia, D., Kintoko, & Siswanto, D. H. (2025). Effectiveness of the scramble learning model on students' ability to understand mathematical concepts. *Contemporary Education and Community Engagement*, *1*(2), 64–73. https://doi.org/10.12928/cece.v1i2.1282

Apriliya, & Basir, M. A. (2020). Analisis kemampuan berpikir kreatif matematis siswa pada materi matriks ditinjau dari self-efficacy. *Jurnal Pemikiran dan Penelitian Pendidikan Matematika (JP3M)*, *2*(2), 97–111. https://doi.org/10.36765/jp3m.v2i2.39

Apriwulan, H. F., Hanama, A., Pisriwati, S. A., & Siswanto, D. H. (2025). Library service management as an effort to cultivate students' reading interest in improving activities and learning outcomes. *Curricula: Journal of Curriculum Development*, *4*(1), 199–214. https://doi.org/10.17509/curricula.v4i1.76911

Arikunto, S. (2017). *Prosedur penelitian suatu pendekatan praktik*. Jakarta: Rineka Cipta.

Astiwi, W., Siswanto, D. H., & Suryatama, H. (2024). Description regarding the influence of teacher qualifications and competence on early childhood learning achievement. *Asian Journal of Applied Education (AJAE)*, *3*(3), 347–358. https://doi.org/10.55927/ajae.v3i3.10360

Efendi, R., Siswanto, D. H., & Saputra, S. A. (2025). Deep learning approach to teaching multiplication concepts using coin media: Classroom action research in elementary school. *Jurnal Padamu Negeri*, *2*(2), 87–97. https://doi.org/10.69714/xaewmx28

Fitriana, E., Siswanto, D. H., & Hanama, A. (2025). The impact of thematic worksheet-assisted meaningful learning implementation on students' mathematical concept understanding and metacognitive skills. *Jurnal Praktik Baik Pembelajaran Sekolah dan Pesantren*, *4*(02), 54–67. https://doi.org/10.56741/pbpsp.v4i02.788

Hanama, A., Kristiawan, Y., Siswanto, D. H., & Syah, A. B. P. D. A. F. (2024). Program market day sebagai stimulus untuk mengembangkan karakter kewirausahaan murid sekolah dasar. *MURABBI*, *3*(2), 62–70. https://doi.org/10.69630/jm.v3i2.39

Hayati, R., Rahmi, R., & Delyana, H. (2022). Implementation of Contextual Teaching and Learning (CTL) on students' capability in mathematical problem solving. *Alifmatika: Jurnal Pendidikan dan Pembelajaran Matematika*, *4*(2), 122–134. https://doi.org/10.35316/alifmatika.2022.v4i2.122-134

Johnson, L. B., & Christensen, L. (2014). Educational research: Quantitative, qualitative, and mixed approaches. In T. Accomazzo (Ed.), *SAGE Publications, Inc* (fifth, Vol. 4, Issue 1). SAGE Publications, Inc. https://doi.org/10.4324/9781351004626-12

Kamid, K., Rohati, R., Hobri, H., Triani, E., Rohana, S., & Pratama, W. A. (2022). Process skill and student's interest for mathematics learning: Playing a traditional games. *International Journal of Instruction*, *15*(3), 967–988. https://doi.org/10.29333/iji.2022.15352a

Kintoko, & Siswanto, D. H. (2024). Effectiveness of the Cool-Critical-Creative-Meaningful (3CM) learning model on enhancing students' critical thinking skills. *Jurnal Mercumatika: Jurnal Penelitian Matematika dan Pendidikan Matematika*, *9*(1), 23–29. https://doi.org/10.26486/jm.v9i1.4522

Kintoko, Siswanto, D. H., Pamungkas, M. D., & Aisyah, A. K. (2025). Analysis of students' mathematical literacy skills on the Pythagorean Theorem in Junior High School. *JOELI: Journal of Educational and Learning Innovation*, *1*(3), 180–190. https://doi.org/10.72204/j6t4a573

Kurniawan, R., Silalahi, L. B., Limbong, C., & Tambunan, H. (2021). Analisis literasi, komunikasi dan penalaran matematika terhadap hasil belajar siswa selama pembelajaran E-Learning. *Jurnal Pendidikan Matematika*, *4*(1), 56–70. https://doi.org/10.31539/judika.v4i1.2312

Lestari, F. P., Ahmadi, F., & Rochmad, R. (2021). The implementation of mathematics comic through contextual teaching and learning to improve critical thinking ability and character. *European Journal of Educational Research*, *10*(1), 497–508. https://doi.org/10.12973/EU-JER.10.1.497

Millah, M., & Wildani, A. (2023). The effect of Contextual Teaching and Learning (CTL) model with the assistance of snake and ladder media on rtudent physics learning outcomes. *EduFisika: Jurnal Pendidikan Fisika*, *8*(1), 46–51. https://doi.org/10.59052/edufisika.v8i1.19156

Muslimin, M. (2023). Enhancing teachers' competence in developing lesson plans through continuous guidance: A school action research. *Didaktika: Jurnal Kependidikan*, *17*(1), 83–98. https://doi.org/10.30863/didaktika.v17i1.5099

Putri, H. A., Siswanto, D. H., & Suryatama, H. (2025). Development of student book as a means to instill social care, honesty, and responsibility to enhance academic achievement in elementary school. *International Journal of Learning Reformation in Elementary Education*, *4*(01), 1–17. https://doi.org/10.56741/ijlree.v4i01.744

Safitri, R., Hadi, S., & Widiasih, W. (2023). Effect of the problem based learning model on the students motivation and learning outcomes. *Jurnal Penelitian Pendidikan IPA*, *9*(9), 7310–7316. https://doi.org/10.29303/jppipa.v9i9.4772

Sinaga, S. J., Hutabarat, G. I. C., Nababan, Y. J., Turnip, F. C., & Hutauruk, A. J. . (2023). Peningkatan motivasi belajar siswa melalui Contextual Teaching and Learning (CTL) pada pembelajaran perbandingan di SMP Free Methodist 1 Medan. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, *7*(1), 681–694. https://doi.org/10.31004/cendekia.v7i1.1865

Siswanto, D. H. (2025). The impact of a collaborative problem-based learning on performance in inverse matrix learning, critical thinking skills, and student anxiety. *Contemporary Education and Community Engagement*, *1*(2), 1–11. https://doi.org/10.12928/cece.v1i2.1034

Siswanto, D. H., Alghiffari, E. K., & Pujiastuti, N. I. (2024). Implementation of the CTL model as a strategy to increase interest in learning mathematics. *Indonesian Journal of Educational Science and Technology (Nurture)*, *3*(2), 61–74. https://doi.org/10.55927/nurture.v3i2.9168

Syah, A. B. P. D. A. F., Rachmawati, L., & Siswanto, D. H. (2024). Validity and practicality of the game-based learning media for mathematical logic using the quiz whizzer application. *JOELI: Journal of Educational and Learning Innovation*, *1*(2), 107–118. https://doi.org/10.72204/xpxg2d74

Tarso, Siswanto, D. H., & Setiawan, A. (2025). Teacher qualifications in the implementation of the Kurikulum Merdeka and ISMUBA. *Curricula: Journal of Curriculum Development*, *4*(1), 13–28. https://doi.org/10.17509/curricula.v5i1.76836

Wahyuni, N., Alam, S. R., Alghiffari, E. K., & Siswanto, D. H. (2024). Harnessing TikTok for learning: Examining its impact on students' mathematical numeracy skills. *Journal of Professional Teacher Education*, *02*(02), 48–56. https://doi.org/10.12928/jprotect.v2i2.945

Wantoro, H., Misbahul, M., & Siswanto, D. H. (2025). Development of a guided discovery-based scientific approach mmdule for enhancing problem-solving skills. *Contemporary Education and Community Engagement*, *1*(2), 51–63. https://doi.org/10.12928/cece.v1i2.1271

Welerubun, R. C., Wambrauw, H. L., Jeni, J., Wolo, D., & Damopolii, I. (2022). Contextual teaching and learning in learning environmental pollution: The effect on student learning outcomes. *Prima Magistra: Jurnal Ilmiah Kependidikan*, *3*(1), 106–115. https://doi.org/10.37478/jpm.v3i1.1487

Yogyanto, N., Pisriwati, S. A., & Siswanto, D. H. (2024). Education on the contextual utilization of information technology based on the IoT in the daily lives of senior high school students. *Civitas: Jurnal Pengabdian Masyarakat*, *1*(1), 21–27. https://doi.org/10.61978/civitas.v1i1.335