

Efforts to Improve the Mathematical Literacy Skills of 10th Grade Student Using the Connecting, Organizing, Reflecting, Extending (CORE) Learning Model at Gama Santren High School in Yogyakarta

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ARTICLE INFO	ABSTRACT
Published Online: 30 April 2026	This study aims to improve students' mathematical literacy ability through the implementation of the Connecting, Organizing, Reflecting, and Extending (CORE) learning model on the topic of trigonometric ratios. The research employed Classroom Action Research (CAR) conducted in two cycles, each consisting of planning, action, observation, and reflection stages. The subjects of this study were 16 tenth-grade students at SMA GAMA Yogyakarta in the 2024/2025 academic year. The results showed a significant improvement in students' mathematical literacy ability across each cycle. In the initial test, the average score was 39.05, with a classical mastery level of 13%. After the implementation of Cycle I, the average score increased to 59.68, with a mastery level of 25%. Furthermore, in Cycle II, the average score reached 76.00, with a classical mastery level of 88%, indicating that the predetermined success criteria had been achieved. In terms of aspects, the communication skill showed the most substantial improvement, followed by mathematizing, while reasoning and devising strategies for solving problems still require further enhancement. Overall, the findings indicate that the CORE learning model is effective in gradually improving students' mathematical literacy ability, particularly in fostering active engagement and meaningful learning.
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KEYWORDS: Mathematical Literacy; CORE Learning Model; Classroom Action Research; Trigonometry; Learning Improvement	

I. INTRODUCTION

In the modern era, education plays a strategic role in shaping human resources capable of addressing increasingly complex global developments. Education serves not only as a process of knowledge transfer but also as a means to develop critical, creative, and adaptive thinking skills to address various life challenges. Education is a learning process aimed at enhancing knowledge, skills, and creativity, as well as shaping students' character. According to Zulkifli et al. (2023), education is a basic human need and a process for humanizing humanity. In this context, mathematics learning is a crucial component as it plays a role in training logical, systematic, and analytical thinking skills.

Mathematics is a foundational science that underpins the development of various disciplines and plays a role in solving everyday problems. Fahrurrozi and Syukrul (2017) state that

mathematics is a systematic discipline that examines patterns of thought and relationships and is used to understand various problems in life. Therefore, mathematics education focuses not only on mastering concepts but also on the ability to apply those concepts in various real-world situations.

However, in reality, students still often find mathematics difficult. Syakur, Purnamasari, and Kumia (2021) state that students tend to view mathematics as an abstract, boring, and difficult-to-understand subject. This is due to a learning process that remains focused on procedures and fails to connect the material to real-life contexts, leaving students unable to develop critical thinking and problem-solving skills.

One of the most important skills in mathematics education is mathematical literacy. Mathematical literacy is not limited to computational skills but also encompasses the ability to

formulate, apply, and interpret mathematics in various real-life contexts (OECD, 2019). This skill includes mathematical reasoning, the use of concepts and procedures, as well as the ability to solve contextual problems. This aligns with research conducted by Rizal, Sukirwan & Madawistama (2025); Afifah et al, (2024), which shows that mathematical literacy is closely related to logical thinking, problem-solving, and data-driven decision-making.

However, various studies indicate that students' mathematical literacy skills in Indonesia remain relatively low. The low level of mathematical literacy among Indonesian students is not only evident in national research findings but is also corroborated by the results of the Programme for International Student Assessment (PISA). PISA results show that Indonesian students' mathematical literacy skills remain in the low category and have tended to stagnate over a long period. According to the Programme for International Student Assessment (PISA) report, Indonesia's mathematics score declined from 379 in 2018 to 366 in 2022, remaining more than 100 points below the OECD average—which stood at 489 in 2018 and 472 in 2022. Indonesia ranks among the lowest globally, at approximately 73rd out of 79 countries in 2018 and around 70th out of 81 countries in 2022 (OECD, 2019; OECD 2022).

This situation indicates that mathematics education in Indonesia is still dominated by low-order thinking skills (LOTS) and has not yet optimally developed higher-order thinking skills (HOTS). More than 70% of students are only able to solve Level 1 problems, which are routine and simple in nature. Meanwhile, only a small proportion of students are able to reach Level 2 or higher, which requires critical, analytical, and complex problem-solving skills (OECD, 2019; OECD 2022; Dewi, Purnomo & Sulistyaningsih, 2025). Meanwhile, National Assessment data shows that Indonesian students' numeracy skills have improved, but are still not optimal. The proportion of students achieving the minimum numeracy competency increased from 45.24% in 2022 to 62.45% in 2023 and 67.94% in 2024. Nevertheless, approximately one-third of students have not yet reached the minimum numeracy competency, indicating that Indonesian students' mathematical literacy skills still need to be significantly improved (medcom.id, 2025).

This low level of achievement is particularly evident in students' ability to solve context-based (contextual) problems. Students struggle to understand the problem, translate it into a mathematical model, and interpret the resulting solution. Yet these skills are at the core of mathematical literacy. Several studies also indicate that students tend to be weak in understanding basic concepts, slow in solving problems, and unfamiliar with problem-solving-based questions (Hewi & Shaleh, 2020; Nur'aini et al., 2021; Yanto & Rahaju, 2024; Dewi, Purnomo &

Sulistyaningsih, 2025; Qomaria, Sumartono & Prastiwi, 2025).

Various studies indicate that students' mathematical literacy skills in Indonesia remain relatively low. A literature review by Aliefani, Fuat, and Lestari (2025) reveals that most research on mathematical literacy in Indonesia still yields suboptimal results, particularly regarding students' ability to understand and solve problems based on real-world contexts. Furthermore, bibliometric research also indicates that although the number of studies on mathematical literacy has increased significantly in recent years, the research focus remains dominated by ability analysis rather than on sustainable learning interventions (Warsitasari, 2024). Risdianti et al. (2024) demonstrated in their study that low mathematical literacy is influenced by an unsupportive learning environment and ineffective teaching strategies in developing higher-order thinking skills. Another empirical study by Fitria, Ubaidah & Basir (2025) indicates that students still face difficulties in solving mathematical literacy problems, particularly in the stages of understanding the problem and interpreting the solution. Furthermore, other research suggests that learning that remains oriented toward conventional methods prevents students' mathematical literacy skills from developing optimally (Fahlefi, Anggoro & Sugiharta, 2025).

This low level of mathematical literacy is closely linked to a learning process that does not yet support the development of higher-order thinking skills. Mathematics instruction remains largely teacher-centered and fails to provide students with sufficient opportunities to develop critical, reflective, and contextual thinking skills. In fact, mathematical literacy requires students to be able to connect mathematical concepts to real-life situations and apply them in decision-making.

Based on the results of initial observations conducted at GAMA Santren High School in Yogyakarta, several issues were identified in mathematics instruction for 10th-grade students, namely: (1) students struggle to solve context-based problems or real-world problems; (2) students tend to memorize formulas without understanding the underlying concepts; (3) students' ability to interpret problems into mathematical models remains low; (4) students are not very active in learning and rely on the teacher's explanations; and (5) the results of the initial test indicate that most students fall into the low category in mathematical literacy. These conditions indicate that students' mathematical literacy skills still need to be improved through enhancements to the classroom learning process.

This situation indicates a need for innovations in learning that can enhance student engagement while developing mathematical literacy skills. One learning model that can be utilized is the Connecting, Organizing, Reflecting, Extending (CORE) model. The CORE model emphasizes the process of connecting prior knowledge, organizing information,

reflecting on understanding, and expanding knowledge further. Previous research has shown that the CORE model is effective in improving students' mathematical literacy skills through active and meaningful learning processes (Nasrulloh et al, 2023). Additionally, other studies indicate that the CORE model has a positive impact on students' mathematical representation and reasoning skills (Widiastuti et al, 2022). Nevertheless, some studies indicate that the implementation of the CORE model has not yet been fully optimized across all aspects of mathematical ability and remains influenced by learning conditions and student characteristics (Sari & Karyati, 2020). Furthermore, most previous studies still have limitations, namely that they were primarily conducted at the junior high school level, used experimental methods, and did not specifically examine mathematical literacy skills in the context of real-world classroom learning. Thus, there is a research gap, namely: (1) research on the CORE model has been conducted primarily at the junior high school level, while research at the senior high school level remains limited; (2) there is a scarcity of Classroom Action Research (CAR)-based studies focused on direct improvements in learning; and (3) research integrating the CORE model with the enhancement of mathematical literacy in real-world contexts (CAR) remains very scarce.

Through the implementation of the CORE model, students are expected to become more active in constructing knowledge, developing critical thinking skills, and improving their mathematical literacy. Therefore, this study was conducted as a Classroom Action Research (CAR) project.

II. METHOD

This research falls into the category of classroom action research (CAR), with implementation stages including: planning, implementation/action, evaluation, and reflection. Classroom action research (CAR) aims to find solutions to problems that arise in a classroom through the application of effective learning strategies or methods.

Classroom action research consists of several cycles. "Circle," meaning "round," refers to the four steps each cycle goes through: preparation, action, observation, and reflection. Each cycle is implemented according to the desired change. In this study, two cycles were conducted until the desired improvement in mathematical communication skills was achieved.

Arikunto (2013) explains that one CAR cycle consists of four steps: (1) planning, (2) implementation, (3) observation, and (4) reflection.

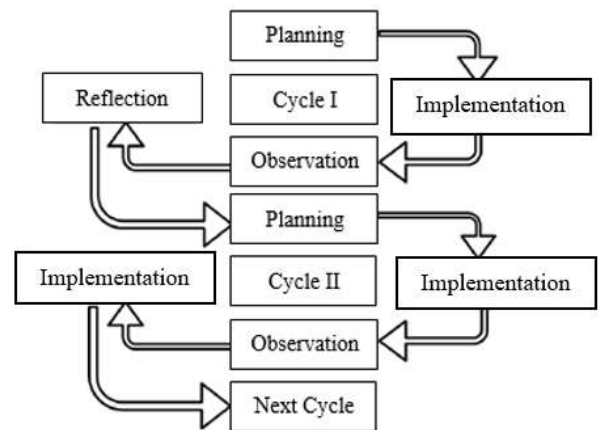


Figure I. Classroom Action Research Procedures

The cycle was terminated when the students in the research class showed improvement, as indicated by the achievement of the mathematical literacy indicators.

This research was conducted at GAMA High School in the even semester of the 2024/2025 academic year. The subjects were 16 tenth-grade Mathematics students at GAMA High School. The object of this study was students' mathematical literacy skills in the topic of Trigonometry.

In this study, the mathematical literacy skills test was conducted in several stages, including an initial ability test, a mathematical literacy skills test I (after cycle I), a mathematical literacy skills test II (after cycle II), and so on. The purpose of these tests was to observe the development of students' mathematical literacy skills as the classroom action research progressed. The mathematical literacy test will cover aspects such as students' ability to express mathematical ideas or concepts relevant to existing problems (Communication), transform real-world problems into mathematical forms (Mathematicizing), think logically to draw conclusions, verify or provide valid statements or solutions to problems (Reasoning and Argumentation), and apply sequential steps to solve problems (Devising Strategies for Solving Problems).

Students' success in solving problems is determined based on criteria that refer to their level of mathematical literacy in relation to the material being taught. This means that students' learning achievement is measured based on a raw score that indicates their level of mathematical literacy in relation to the material presented. Students' mathematical literacy levels are grouped into five categories (Arifin, 2011: 236), as follows.

Table 1. Mastery Level of Mathematical Literacy Ability

No.	Mastery Level (%)	Criteria
1	90 – 100	Very High
2	80 – 89	High
3	70 – 79	Moderate
4	60 – 69	Low
5	≤ 59	Very Low

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The determination of the percentage of students' mathematical literacy ability at the class level (classical completeness) can be calculated using the following formula (Trianto, 2011):

$$PKK = \frac{M}{N} \times 100\%$$

Explanation:

PKK : Percentage of Student Mathematical Literacy Ability

M : Number of students who achieve at least the minimum score in the *moderate* category

N: Total number of students

Criteria:

$PKK \geq 85\%$: The class's mathematical literacy ability has reached a good standard.

$PKK < 85\%$: The class's mathematical literacy ability has not yet reached a good standard.

Students are considered to have met the criteria for mathematical literacy ability if they achieve at least the *moderate* category ($\geq 70\%$). The target for improving mathematical literacy ability is considered achieved if 85% of the total students who take the test have reached at least the *moderate* category.

III. RESULT

A. Research Problem I

Based on the results of the initial assessment, the average level of students' mathematical literacy can be determined. An analysis of the criteria for students' mathematical literacy from the initial assessment is presented in Table 2 below.

Table. 2 Description of Initial Mathematical Literacy Ability

No.	Score	Ability Level	Number of Student	%	Average Ability Score
1	90 – 100	Very High	0	0%	39.05
2	80 – 89	High	0	0%	Very
3	70 – 79	Moderate	2	12.50%	Low
4	60 – 69	Low	3	18.75%	
5	≤ 59	Very Low	11	68.75%	

Based on Table 2, it can be observed that students' mathematical literacy ability in the initial assessment falls into the very low category. Out of 16 students, only 2 students (12.50%) achieved the minimum mastery criterion ($MMC \geq 70$), while 14 students (87.50%) did not meet the required minimum score. The average score of the students was 39.05. These findings indicate that students' mathematical literacy ability in the initial assessment is classified as very low.

Furthermore, students' mathematical literacy ability in the initial assessment across each aspect is described as follows.

Table 3. Average Initial Mathematical Literacy Ability by Aspect

No.	Aspect	Average Score	Criteria
1	Communication	43.22	Very Low
2	Mathematizing	37.50	Very Low
3	Reasoning and Argument	20.83	Very Low
4	Devising Strategies for Solving	17.18	Very Low

Table 3 shows the average scores of students' initial mathematical literacy ability across each aspect, namely communication, mathematizing, reasoning and argument, and devising strategies for solving. All aspects fall into the very low category, with the highest score observed in the communication aspect (43.22) and the lowest in the devising strategies for solving aspect (17.18). This indicates that students' mathematical literacy ability in the initial assessment still needs to be improved in all aspects.

SIKLUS I

The results of students' mathematical literacy ability test in Cycle I can be seen in Table 4 as follows,

Table 4. Average Mathematical Literacy Ability of Student in Cycle I

No.	Score	Ability Level	Number of Student	%	Average Ability Score
1	90 – 100	Very High	0	0%	
2	80 – 89	High	2	12.5%	59.68
3	70 – 79	Moderate	4	25%	Very
4	60 – 69	Low	3	18.75%	Low
5	≤ 59	Very Low	7	43.75%	

Based on the results of the mathematical literacy test administered in Cycle I to 16 students at SMA GAMA Yogyakarta, the average score obtained was 59.68, which falls into the *very low* category. Among the students, 1 student (6%) was classified in the *high* category, 3 students (19%) in the *moderate* category, 3 students (19%) in the *low* category, and 9 students (56%) in the *very low* category. In this cycle, the level of classical mastery achieved was 25%. Furthermore, students' mathematical literacy ability in the Cycle I assessment across each aspect is described as follows.

Table 5. The Average of Students' Mathematical Literacy Ability Across Each Aspect in Cycle I

No.	Aspect	Average Score	Criteria
1	Communication	53.12	Very Low
2	Mathematizing	41.67	Very Low
3	Reasoning and Agument	45.83	Very Low
4	Devising Strategies for Solving	41.67	Very Low

Based on Table 5, which presents the average scores of students' mathematical literacy ability across each aspect in Cycle I, the communication aspect achieved the highest average score of 53.12. Meanwhile, the mathematizing and devising strategies for solving aspects obtained the same average score of 41.67. The reasoning and argument aspect recorded an average score of 45.83. Although there is an observable improvement compared to the initial assessment, all aspects of mathematical literacy ability remain within the *very low* category. Therefore, further efforts are required to enhance students' mathematical literacy skills in the subsequent cycle.

B. Research Problem II

After implementing the CORE learning model in Cycle I for Grade X students at SMA GAMA Seturan Yogyakarta, several weaknesses were identified during the learning process. These weaknesses were subsequently analyzed to determine their underlying causes, so that appropriate improvements could be made in Cycle II.

Following the implementation of the CORE learning model over two meetings, a second mathematical literacy test was administered during the third meeting. This test was completed independently by the students and aimed to measure the improvement in each student's mathematical literacy ability. In addition, the results of this test were used to identify various difficulties encountered by students in solving the given problems. The data on students' mathematical literacy test results in Cycle II are presented in Table 6 below.

Table 6. Verage of Students' Mathematical Literacy Ability in Cycle II

No.	Score	Ability Level	Number of Student	%	Average Ability Score
1	90 – 100	Very High	2	13%	76 Moderate
2	80 – 89	High	3	19%	
3	70 – 79	Moderate	9	56%	
4	60 – 69	Low	2	13%	
5	≤ 59	Very Low	0	0%	

Based on the results of the mathematical literacy test administered in Cycle II to 16 students at SMA GAMA Yogyakarta, the average score obtained was 76.00, which falls into the *moderate* category. Among the students, 2 students (13%) were classified in the *very high* category, 3 students (19%) in the *high* category, 9 students (56%) in the *moderate* category, 2 students (13%) in the *low* category, and none of the students (0%) were in the *very low* category. In this cycle, the level of classical mastery achieved was 88%, which meets the required criterion of classical completeness ($\geq 80\%$).

The implementation of the Connecting, Organizing, Reflecting, and Extending (CORE) learning model in this study was able to improve students' mathematical literacy ability on the topic of trigonometric ratios. In the initial test, the average score of students' mathematical literacy ability was 39.05, with a mastery level of only 13% (2 out of 16 students).

After the implementation of the learning process in Cycle I, there was an improvement in students' mathematical literacy ability, with the average score increasing to 59.68 and the level of learning mastery rising to 25% (6 out of 16 students). A more significant improvement occurred in Cycle II, where the average score reached 76.00, with a mastery level of 88% (14 out of 16 students). These findings indicate that the CORE learning model is effective in gradually enhancing students' mathematical literacy ability. Furthermore, the average of students' mathematical literacy ability for each aspect in Cycle II can be seen in Table 7 below,

Table 7. The Average of Students' Mathematical Literacy Ability Across Each Aspect in Cycle II

No.	Aspect	Average Score	Criteria
1	Communication	66.66	Moderate
2	Mathematizing	60.93	Low
3	Reasoning and Agument	50.52	Very Low
4	Devising Strategies for Solving	47.39	Very Low

Table 7 presents the average scores of students' mathematical literacy ability across each aspect after the implementation of Cycle II. The communication aspect achieved the highest average score of 66.66 and falls into the *moderate* category. The mathematizing aspect obtained a score of 60.93, which is classified as *low*. Meanwhile, the reasoning and argument and devising strategies for solving aspects remain in the *very low* category, with average scores of 50.52 and 47.39, respectively.

These results indicate that although not all aspects have reached a high category, there has been a significant

improvement in students' mathematical literacy ability compared to the previous cycle. The communication aspect shows the most substantial development, suggesting that the CORE learning approach effectively encourages students to be more active in expressing mathematical ideas, both orally and in written form.

IV. DISCUSSION

The results obtained by applying the Connecting, Organizing, Reflecting, Extending (CORE) learning model in this study demonstrated an improvement in students' mathematical literacy skills regarding trigonometric ratios. In the pre-test, the average mathematical literacy score was 39.05, with 2 out of 16 students achieving mastery equivalent to 13%. After implementing the instruction in Cycle I, it was found that students' mathematical literacy skills improved, with the average mathematical literacy score rising to 59.68 and 4 out of 16 students achieving mastery, or 25%. In Cycle II, students' mathematical literacy skills continued to improve, with the average score reaching 76 and 14 out of 16 students achieving mastery, or 88%.

Based on the results obtained, it is evident that students' average scores improved from 66 in Cycle I to 76 in Cycle II. The complete results can be seen in Table VIII.

Table 8. Description of Students' Literacy Ability Levels in Each

No.	Score	Ability Level	Initial Test	Cycle I	Cycle II
1	90 – 100	Very High	0	0	2
2	80 – 89	High	0	2	3
3	70 – 79	Moderate	2	4	9
4	60 – 69	Low	3	3	2
5	≤ 59	Very Low	11	7	0
Total			16	16	16
Average			39.05	59.58	76
Classical Percentage			12.50%	38%	88%

The research results showed a gradual increase in student abilities from the initial test, Cycle I, to Cycle II. During the initial test, the distribution of student abilities was still dominated by the low category, particularly the very low category, which reached 11 students, while there were no students in the high or very high categories. This condition indicates that students' initial abilities were still at an inadequate level to meet the expected competency indicators. After implementing the actions in Cycle I, a shift in the distribution of student abilities began to emerge. The number of students in the very low category decreased from 11 to 9 students. Conversely, a student in the high category began to emerge, albeit in a limited number, at 1 student. Furthermore, the number of students in the adequate category also

increased. However, the overall distribution of student abilities in Cycle I still tended to be concentrated in the low and very low categories. This indicates that the actions in Cycle I were not fully optimal in significantly improving student abilities.

The learning improvements implemented in Cycle II had a more substantial impact, as evidenced by the absence of students in the very low category. Furthermore, there was a significant increase in the sufficient category, reaching 9 students, and an increase in the high and very high categories to 3 and 2 students, respectively. Conversely, the number of students in the low category decreased to 2 students. This shift indicates a shift in the distribution of abilities from the low category to the higher category.

Overall, these results indicate that the implemented learning interventions were able to effectively improve student abilities. This improvement was evident not only in the reduction in the number of students in the low category, but also in the increase in the number of students in the sufficient, high, and very high categories. Therefore, it can be concluded that the learning interventions implemented in this study successfully improved the quality of student abilities gradually and sustainably, achieving optimal results in Cycle II.

V. CONCLUSION

The Connecting, Organizing, Reflecting, Extending (CORE) learning model used in this study can improve students' mathematical problem-solving skills. This improvement is reflected in the results of the mathematical literacy tests, which show progress in each learning cycle. In Cycle I, 6 out of 16 students (38%) achieved mastery with an average score of 59.68, which was still below the classical mastery criteria. However, in Cycle II, the number of students who achieved mastery increased significantly to 14 out of 16 students (88%) with an average score of 76.00, thereby meeting the established classical mastery criteria. These findings reinforce that the implementation of the CORE learning model is effective in improving students' mathematical literacy, particularly in the context of problem-solving.s

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