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The Impact of Contextual Teaching and Learning on Mathematical Literacy and Its Five Aspects Across Educational Levels: A Systematic Literature Review

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Abstract

This study aims to describe the influence of implementing the Contextual Teaching and Learning (CTL) approach on improving students' mathematical literacy skills across various educational levels. The study employs a Systematic Literature Review method involving 30 selected articles that discuss the application of CTL in mathematical literacy and its five components. The findings indicate that the implementation of CTL consistently enhances all aspects of mathematical literacy significantly compared to conventional methods. In addition, supporting factors were identified, including the relevance of learning materials to real-world contexts, the active role of teachers, and the use of technology. Conversely, inhibiting factors include limited teacher competence, restricted instructional time, and inadequate ICT facilities. Previous studies also exhibit limitations such as small sample sizes, short intervention durations, and incomplete research designs. Overall, CTL has been proven to positively contribute to improving mathematical literacy within real-world-based learning contexts.

Keywords: *Impact; Influence; Effect; Contextual Teaching and Learning; Mathematical Literacy; Representation; Problem Solving; Connections; Reasoning; Communication*

Introduction

Mathematics is a fundamental discipline studied at every educational level, from elementary school to higher education. This subject plays an essential role in shaping individuals who are capable of thinking critically, acting responsibly, and collaborating within society (Sachdeva & Eggen, 2021). As a fundamental skill in daily life, mathematics not only serves to solve various practical problems but also supports understanding in numerous other fields of knowledge (Laurens et al., 2017). In the rapidly evolving era of globalization and digitalization, students' abilities to comprehend, reason, and apply mathematical concepts functionally have become increasingly necessary. One of the key competencies in

the context of mathematics learning is mathematical literacy, which refers to the ability to understand, formulate, apply, and interpret mathematical concepts and procedures in various real-world situations effectively (Kanthawat et al., 2019; Stacey, 2015).

Mathematical literacy has become a major focus in various educational policies at both national and international levels. For example, in the Programme for International Student Assessment (PISA), mathematical literacy is defined as students' ability to formulate, use, evaluate, and interpret mathematics within real-world contexts (OECD, 2023). The competencies assessed in mathematical literacy in PISA 2022 can be further categorized into several aspects, namely representation, symbolic operations, Problem Solving strategies, mathematical connections, reasoning, and communication. These competencies reflect mathematical thinking processes that involve the use of concepts, procedures, facts, and mathematical tools to understand, explain, and predict various phenomena. In Indonesia, mathematical literacy is also an integral part of the Minimum Competency Assessment (AKM), which aims to measure students' mastery of essential mathematical competencies to improve the quality of learning processes and outcomes (Pusmenjar, 2020). Through the mastery of mathematical literacy, students are expected to interpret data-based information, understand the application of mathematics in real-life contexts, and make logical and rational decisions. Thus, mathematical literacy is a crucial skill that every student must possess to effectively respond to the complex challenges of the twenty-first century.

The application of mathematical literacy in real-life or daily situations remains a challenge for many students, particularly in understanding and applying mathematical concepts. Rum & Juandi (2022) reported that students often experience difficulties in interpreting contextual problems, performing arithmetic operations, constructing appropriate mathematical models, and communicating solutions coherently. Similar findings were presented by Rusmining & Sawitri (2022), who found that more than 80% of students were unable to formulate problems in mathematical form, 92% struggled to apply concepts and procedures accurately, and 88% failed to draw conclusions or evaluate the problems they faced. These challenges hinder the functional application of mathematics in everyday life. Therefore, effective solutions are needed to address these issues. One such solution involves implementing relevant and contextual learning approaches that help students understand mathematical concepts more deeply, apply them effectively, and connect them to their daily realities.

One learning approach believed to address these challenges is Contextual Teaching and Learning (CTL). The CTL approach emphasizes the importance of linking learning materials to students' real experiences and everyday situations so that the learning process becomes more meaningful and relevant (Ahmad, 2019). Through CTL, students are actively engaged in various learning activities such as inquiry, reflection, group discussions, and contextual projects. This approach not only promotes a deeper understanding of mathematical concepts but also enables students to relate mathematical knowledge to concrete situations in their daily lives.

Various previous studies have demonstrated that the CTL approach contributes positively to improving mathematics learning outcomes, including the development of higher-order thinking skills. Its implementation has been shown to positively impact students' mathematical literacy skills (Munandar & Panjaitan, 2023; Putri et al., 2024). One aspect of mathematical literacy that has shown improvement is communication skills, which develop significantly through CTL-based learning (Agustyaningrum & Widjajanti, 2013; Firmansyah et al., 2018; Khamid & Santosa, 2016). Other skills, such as Problem Solving, have also shown improvement as a positive outcome of CTL implementation in the learning process (Muslihah & Suryaningrat, 2021; Yulinda et al., 2016).

Systematic reviews synthesizing findings on the impact of the CTL approach on students' mathematical literacy remain limited. Although literature reviews on CTL implementation have previously been conducted, most have focused only on specific competencies and have not examined mathematical literacy and its components comprehensively. For example, Dhani & Rahayu (2023) examined CTL implementation in mathematics learning in general, Sunaryo et al. (2023) focused on its influence on critical thinking skills, Fatimah & Mashuri (2024) concentrated on improvements in representation skills, while Dewi (2025) highlighted its impact on Problem Solving abilities. These

conditions indicate the need for a systematic review that synthesizes research findings more comprehensively and holistically.

This article specifically elaborates on various research findings regarding the impact of the CTL approach on students' mathematical literacy skills. The discussion begins with a description of the general characteristics of the reviewed studies, followed by an analysis of the role of CTL in mathematical literacy and its five key components, namely representation, problem solving, connections, reasoning, and mathematical communication within real-world contexts. In addition, this review identifies supporting and inhibiting factors related to the role of CTL in enhancing mathematical literacy and discusses the limitations of the analyzed studies. The purpose of this article is to conduct a systematic review of research examining the role of the CTL approach in developing students' mathematical literacy skills. This article is developed based on the analysis and synthesis of relevant scientific literature and is expected to provide theoretical and practical contributions to the development of instructional approaches grounded in mathematics literacy.

Research Method

This study employs the Systematic Literature Review (SLR) method, a research approach aimed at comprehensively identifying, evaluating, and interpreting various research findings related to specific research questions, particular topics, or phenomena under investigation (Chigbu et al., 2023). The implementation of this study follows the procedures outlined by Xiao & Watson (2019), which include four main stages: (1) establishing inclusion and exclusion criteria; (2) searching for relevant literature; (3) selecting studies based on the inclusion and exclusion criteria; and (4) evaluating the quality and eligibility of the selected sources.

The population in this study consists of scientific articles relevant to the assessment theme and published within the past ten years. The sample selection was conducted using purposive sampling, in which articles were chosen based on their relevance to the research topic. Data collection was carried out by reviewing and gathering relevant articles through academic databases such as Google Scholar and Scopus. The keywords used in searching for relevant articles included "contextual teaching and learning" OR "CTL approach" AND "mathematical literacy" OR "mathematics literacy" AND "impact" OR "effect" OR "influence" AND "representation" OR "problem solving" OR "mathematical connection" OR "reasoning" OR "communication." The detailed inclusion and exclusion criteria for this study are presented in Table 1.

Table 1. Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Title and article content	Titles relevant to the research topic and containing the research keywords	Titles not relevant to the research topic and not containing the research keywords
Year of publication	2015–2025	Publications outside the specified time range
Type of publication	Journal articles	Review papers, editorials, and other non-empirical studies
Research method	Quantitative	Qualitative, developmental, and mixed-method studies
Language	Indonesian and English	Languages other than Indonesian and English
Field of study	Mathematics	Non-mathematics fields
Accessibility	Full-text articles	Incomplete articles

The PRISMA flow diagram is presented in Figure 1.

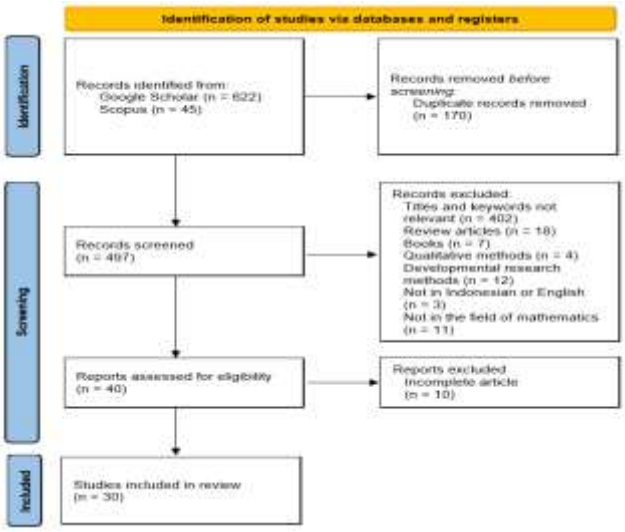

Figure 1. PRISMA Flow Diagram for Systematic Reviews

Subsequently, the data were analyzed using the interactive analysis technique proposed by Miles & Huberman (1994), which consists of three main stages. The first stage is data reduction, namely the process of sorting and simplifying data based on criteria relevant to the focus of this study, such as the relationship between the Contextual Teaching and Learning (CTL) approach and mathematical literacy, as well as the coverage of the five main aspects of mathematical literacy: problem solving, mathematical communication, representation, reasoning, and connection.

The second stage is data display, which involves organizing and categorizing research findings into specific themes, then presenting them systematically and comprehensibly in tabular form. These tables provide summaries of the relevant studies, including essential information and the main findings of each research work. The third stage is conclusion drawing and data verification. At this stage, the researchers conduct an in-depth interpretation of the presented data to obtain valid conclusions that align with the objectives of the review.

Results and Discussion

Based on the selection process using the predetermined inclusion and exclusion criteria, a total of 30 relevant articles were obtained that discuss the impact of the Contextual Teaching and Learning (CTL) approach on mathematical literacy skills, including the five specific aspects of mathematical literacy. Table 2 presents a description of the general characteristics of these 30 articles.

Table 2. Description of the General Characteristics of Studies on CTL in Relation to Mathematical Literacy and Its Five Aspects

No.	Author(s) (Year)	Sample	Educational Level	Mathematical Ability
1.	Megawati et al. (2024)	56 Students	Elementary School	Mathematical Literacy
2.	Buyung (2015)	80 Students	Junior High School	
3.	Wicaksono&Agustyaningrum (2018)	74 Students		
4.	Pranata et al. (2020)	2 Class		
5.	Putri et al. (2024)	60 Students		
6.	Dhani et al. (2025)	80 Students		
7.	Amidi et al. (2025)	64 Students		
8.	Kurniawati et al. (2023)	35 Students	Higher Education (University)	

No.	Author(s) (Year)	Sample	Educational Level	Mathematical Ability
9.	Rustam (2018)	46 Students	Junior High School	Representation
10.	Nuraeni & Sukmaningthias (2020)	46 Students		
11.	Setianto (2020)	92 Students		
12.	Salma & Sumartini (2022)	2 Class		
13.	Damayanti & Afriansyah (2018)	40 Students	Senior High School	
14.	Priyadi & Yumiati (2021)	45 Students	Vocational High School	
15.	Muslihah & Suryaningrat (2021)	48 Students	Elementary School	Problem Solving
16.	Nurjannah et al. (2023)	29 Students		
17.	Utami (2023)	2 Class		
18.	Murnaka et al. (2018)	39 Students	Junior High School	
19.	Purwati et al. (2019)	28 Students		
20.	Bahri & Nasution (2019)	66 Students		
21.	Salmani et al. (2020)	100 Students	Senior High School	
22.	MZ et al. (2021)	2 Class		
23.	Hutabarat et al. (2025)	72 Students		
24.	Latipah & Afriansyah (2018)	61 Students	Junior High School	Connection
25.	Khairunnisak et al. (2020)	23 Students		
26.	Khotimah & Masduki (2019)	34 Students	Higher Education (University)	Reasoning
27.	Ahdhianto et al. (2020)	204 Students	Elementary School	Communication
28.	Susanto et al. (2022)	1 Class	Junior High School	
29.	Agustiani & Jailani (2023)	60 Students		
30.	Purba & Surya (2020)	2 Class	Higher Education (University)	

Based on Table 2, a total of 30 articles were analyzed to identify the general characteristics of studies related to the implementation of the Contextual Teaching and Learning (CTL) approach on mathematical literacy and its five components. The research subjects in most of the studies were students at the elementary school level in 5 articles, junior high school in 17 articles, senior high school in 5 articles, and higher education (university) in 3 articles. The sample sizes varied considerably, ranging from 23 to 204 students or several classes, reflecting the diversity of contexts and populations used in the studies. Based on these findings, the CTL approach has been proven to be implemented across various educational levels and holds substantial potential for developing the components of mathematical literacy.

The Impact of the CTL Approach on Mathematical Literacy Skills and the Five Components of Mathematical Literacy

1. CTL on Mathematical Literacy Skills

Table 3. Results of CTL on Mathematical Literacy Skills

No.	Author(s) (Year)	Research Findings
1.	Megawati et al. (2024)	The implementation of Sasak-culture-based Contextual Teaching and Learning (CTL) was effective in improving the mathematical literacy of third-grade students at SDN 20 Cakranegara. The experimental class recorded an average posttest score of 89.94, higher than the control class score of 78.57. The N-Gain value of 83% in the experimental class was categorized as high, supported by statistically significant results (sig. 0.00 < 0.05), confirming the positive effect of CTL on students' mathematical literacy.
2.	Buyung (2015)	The implementation of the CTL approach integrated with Problem-Based Learning (PBL) significantly enhanced students' mathematical literacy, as indicated by a regression coefficient of 0.528 and an R^2 value of 0.365, demonstrating the positive contribution of students' perceptions to variations in mathematical literacy skills.

No.	Author(s) (Year)	Research Findings
3.	Wicaksono & Agustyaningrum (2018)	The Contextual Teaching and Learning (CTL) approach, combined with the STAD cooperative learning model, was effective in improving students' mathematical literacy at SMP Negeri 4 Batam. This was evidenced by a t-test result showing a t-value of 7.723, which exceeded the t-table value of 1.687.
4.	Pranata et al. (2020)	The use of a contextual approach based on local character and culture through student worksheets (LKPD) was significantly more effective in enhancing students' mathematical literacy than the expository approach. This effectiveness was reflected in higher posttest scores and N-Gain values, as well as positive student responses, with an interest level reaching 76% (categorized as very good).
5.	Putri et al. (2024)	CTL was proven to improve students' mathematical literacy more effectively than conventional instruction, as shown by higher posttest scores and N-Gain values, along with significant differences according to the Mann–Whitney test (sig. < 0.05).
6.	Dhani et al. (2025)	Students who participated in learning using the Contextual Teaching and Learning (CTL) approach demonstrated better mathematical literacy skills compared to those taught using conventional learning methods.
7.	Amidi et al. (2025)	CTL assisted by Articulate Storyline was found to be more effective than the PBL model in improving students' mathematical literacy, in terms of average scores, classical mastery, and overall improvement, particularly among students with high self-confidence.
8.	Kurniawati et al. (2023)	The implementation of CTL effectively enhanced university students' mathematical literacy, as indicated by an increase in mastery from 60% in Cycle I to 82.86% in Cycle II, surpassing the predetermined success criterion of 75%.

Based on the research findings presented in Table 3, Contextual Teaching and Learning (CTL)-based instruction consistently demonstrates its effectiveness in developing mathematical literacy across all educational levels, from elementary school to higher education. All studies reported significant improvements in posttest scores, N-Gain values, and learning mastery in the experimental classes compared to the control classes or conventional instructional methods. Several studies also highlighted the importance of integrating local culture and student character into the implementation of CTL, such as those conducted by Megawati et al. (2024) and Pranata et al. (2020), which showed positive effects on students' interest and responses. Additionally, the use of interactive media such as Articulate Storyline further strengthened the effectiveness of CTL, as demonstrated by Amidi et al. (2025). Overall, the CTL approach not only enhances cognitive learning outcomes but also promotes active engagement and contextual understanding in solving mathematical problems.

2. CTL on Representation Skills

Table 4. Results of CTL on Mathematical Representation Skills

No.	Authors (Year)	Research Findings
1.	Rustam (2018)	The implementation of the contextual approach significantly improved students' mathematical representation skills, as indicated by an average N-Gain of 0.42 (moderate category) and statistical analysis showing significant differences compared to the conventional method.
2.	Nuraeni& Sukmaningthias (2020)	The use of GeoGebra combined with CTL proved effective in enhancing the mathematical representation skills of Grade VIII students at SMP Negeri 9 Palembang, as evidenced by a significant difference between the experimental and control groups (p-value = 0.001).
3.	Setianto (2020)	The RME and CTL approaches were found to be more effective than conventional methods in improving students' mathematical representation skills, with CTL producing the highest average score numerically, although not statistically significant.

No.	Authors (Year)	Research Findings
4.	Salma & Sumartini (2022)	The study concluded that there was a significant difference in students' mathematical representation skills between the CTL and Discovery Learning groups, with both models showing improvements and student attitudes categorized as moderate and adequate.
5.	Damayanti & Afriansyah (2018)	This study demonstrated that CTL was more effective than PBL in improving students' mathematical representation skills, with a high improvement level under CTL and a moderate level under PBL.
6.	Priyadi & Yumiati (2021)	CTL based on outdoor learning was effective in developing students' mathematical representation skills, as shown by the N-Gain of the experimental group surpassing that of the control group. This advantage was supported by contextual learning experiences that stimulated active participation and strengthened students' ability to communicate mathematical ideas.

Based on the research findings summarized in Table 4, the application of the Contextual Teaching and Learning (CTL) approach consistently demonstrates its effectiveness in improving students' mathematical representation skills. All studies indicate that CTL provides greater improvements compared to conventional methods or other learning models such as Problem-Based Learning (PBL) and Discovery Learning. The reported N-Gain values generally fall within the moderate to high categories, as shown in the studies by Rustam (2018) and Damayanti & Afriansyah (2018). Furthermore, the integration of CTL with technology-based learning media, such as GeoGebra used by Nuraeni & Sukmaningthias (2020), as well as CTL with outdoor learning as implemented by Priyadi & Yumiati (2021), further strengthens the effectiveness of this approach in enhancing students' mathematical representation abilities. Overall, CTL has been shown not only to improve learning outcomes but also to promote active student engagement throughout the mathematics learning process.

3. CTL on Mathematical Problem Solving Skills

Table 5. Results of CTL on Mathematical Problem Solving Skills

No.	Authors (Year)	Research Findings
1.	Muslihah & Suryaningrat (2021)	The implementation of the CTL model improved the mathematical Problem Solving skills of Grade V students at SDN 11 KK, indicated by an increase in the average score from 29% to 34%, whereas the control group experienced a decline from 30% to 28%.
2.	Nurjannah et al. (2023)	CTL effectively enhanced learning outcomes and mathematical Problem Solving abilities of Grade V students, as shown by higher average scores and mastery levels in the experimental group compared to the control group.
3.	Utami (2023)	This study demonstrated that the contextual approach effectively improved elementary students' mathematical Problem Solving skills. In addition to statistically significant results, the approach increased students' motivation and understanding by connecting learning materials to real-life contexts.
4.	Murnaka et al. (2018)	Students in the experimental class outperformed those in the control class, with a posttest average of 63.38 surpassing the minimum mastery criterion (KKM) of 60, while the control class remained below the KKM. CTL significantly improved students' Problem Solving skills, supported by Wilcoxon test results (Sig. 0.000) and t-test findings confirming that experimental group scores exceeded the KKM.
5.	Purwati et al. (2019)	A local wisdom–based CTL approach significantly improved students' learning engagement and Problem Solving skills, elevating engagement from "fair" to "good" and improving Problem Solving performance from "very poor" to "fair.
6.	Bahri & Nasution (2019)	CTL effectively enhanced students' Problem Solving skills, as evidenced by increased scores and statistically significant results ($p < 0.05$). Additionally, students' prior mathematical ability did not influence the improvement achieved through CTL.

No.	Authors (Year)	Research Findings
7.	Salmani et al. (2020)	CTL integrated with ICT significantly improved students' mathematical Problem Solving skills, reflected by higher posttest scores compared to those in conventional instruction, along with a positive relationship between students' initial ability and learning outcomes.
8.	MZ et al. (2021)	Students taught using the CTL approach demonstrated higher mathematical Problem Solving skills compared to those learning through conventional methods.
9.	Hutabarat et al. (2025)	The findings indicate that both Cooperative Learning and CTL positively contribute to improving Problem Solving skills and students' sense of responsibility. CTL was particularly effective in relating mathematical concepts to real-life contexts, thereby fostering deeper conceptual understanding.

Based on the findings summarized in Table 5, the implementation of the Contextual Teaching and Learning (CTL) approach consistently shows a positive impact on students' mathematical Problem Solving skills. Most studies demonstrate that CTL not only increases students' average learning scores but also enables them to surpass the minimum mastery criterion (KKM), as reported by Murnaka et al. (2018) and Muslihah & Suryaningrat (2021). Furthermore, Bahri & Nasution (2019) highlight that students' initial ability does not significantly influence CTL's effectiveness, indicating that the approach is adaptable across diverse ability levels. Other studies, such as those by Utami (2023) and Purwati et al. (2019), reveal that CTL enhances not only cognitive performance but also students' motivation and learning engagement. Additionally, ICT-integrated CTL, as demonstrated by Salmani et al. (2020), produces superior outcomes compared to conventional learning. More recent findings by Hutabarat et al. (2025) further reinforce that CTL effectively connects mathematical concepts to everyday life, promoting more meaningful conceptual understanding. Overall, CTL is proven to be both relevant and effective in improving students' mathematical Problem Solving abilities while simultaneously fostering positive learning attitudes and responsibility.

4. CTL on Mathematical Connection Skills

Table 6. Results of CTL on Mathematical Connection Skills

No.	Authors (Year)	Research Findings
1.	Latipah & Afriansyah (2018)	The CTL and RME approaches were shown to effectively improve students' mathematical connection skills at a moderate level, indicated by average posttest scores of 0.558 for CTL and 0.431 for RME.
2.	Khairunnisak et al. (2020)	This study revealed that most students demonstrated low mathematical connection skills, with 73.91% categorized as poor and 26.09% as fair. Students tended to struggle in relating mathematical concepts to real-life contexts, other disciplines, and interrelated mathematical concepts. These findings emphasize the need for strengthening contextual and integrative instructional approaches.

Based on the studies summarized in Table 6, the implementation of the Contextual Teaching and Learning (CTL) approach has been shown to enhance students' mathematical connection skills. Latipah & Afriansyah (2018) found that CTL produced a higher average posttest score compared to the RME approach, although both fell within the moderate category. However, the findings of Khairunnisak et al. (2020) indicate that the majority of students still experience difficulties in connecting mathematical concepts with real-life situations, other fields of study, and relationships among mathematical concepts. These results underscore the importance of implementing CTL more intensively and integratively to optimize students' mathematical connection abilities.

5. CTL on Mathematical Reasoning Skills

Table 7. Results of CTL on Mathematical Reasoning Skills

No.	Authors (Year)	Research Findings
1.	Khotimah & Masduki (2019)	The implementation of a CTL-based Discovery model in the Differential Equations course effectively improved students' mathematical reasoning skills, particularly in problem analysis and solution organization. The average reasoning score demonstrated a significant increase, with the "very good" category achieved in the problem analysis indicator. Students also expressed positive responses toward the use of this model.

Based on the findings summarized in Table 7, the application of the Contextual Teaching and Learning (CTL) approach has been proven effective in improving students' mathematical reasoning skills. Khotimah & Masduki (2019) reported that CTL significantly promoted the development of students' abilities in analyzing problems and organizing solutions within the Differential Equations course.

6. CTL on Mathematical Communication Skills

Table 8. Results of CTL on Communication Skills

No.	Authors (Year)	Research Findings
1.	Ahdhianto et al. (2020)	The implementation of Metacognitive-Based Contextual Learning (MBCL) significantly improved students' mathematical Problem Solving and communication skills compared to the conventional method. The experimental group achieved an average score of 75.65 (SD = 11.17), while the control group obtained 64.30 (SD = 10.42). ANOVA results indicated an F-value of 56.151 ($p < 0.05$), showing a significant difference.
2.	Susanto et al. (2022)	The Moodle-assisted CTL model was proven effective in enhancing students' mathematical communication skills, as evidenced by an increase in the average score from 70.45 (pretest) to 86.6 (posttest), with an N-Gain of 0.57 categorized as moderate.
3.	Agustiani & Jailani (2023)	The CTL approach contributed positively to improving students' learning outcomes, communication skills, and critical thinking abilities. The experimental class showed an increase in average learning achievement from 23.6 to 80 and in basic competency mastery from 23% to 79.1%, surpassing the control class, which also improved but to a lesser extent. Although both approaches were effective, CTL demonstrated more optimal results.
4.	Purba & Surya (2020)	The implementation of CTL improved students' mathematical understanding and positive attitudes. The experimental class exhibited a significant score increase (from 60.5 to 78.2) compared to the control class (from 59.8 to 74.9), supported by a significant t-test result (t-count 3.45 > t-table 2.00; $p < 0.05$).

Based on the research results presented in the table, the implementation of the Contextual Teaching and Learning (CTL) approach, including its variants such as MBCL and Moodle assisted CTL, consistently demonstrates positive effects on the improvement of students' mathematical abilities. Ahdhianto et al. (2020) showed that MBCL significantly enhanced students' mathematical Problem Solving and communication skills compared to conventional instruction. Susanto et al. (2022) confirmed the effectiveness of Moodle-assisted CTL in improving mathematical communication skills, as indicated by the increase in posttest scores and moderate N-Gain. Furthermore, Agustiani & Jailani (2023) reported that CTL not only improved learning outcomes but also strengthened students' critical thinking skills more effectively than the control group. Similar findings were reported by Purba & Surya (2020), who demonstrated that CTL effectively improved students' mathematical understanding and positive attitudes, supported by statistically significant score differences. Overall, CTL has been proven effective in developing both cognitive and affective aspects within mathematics learning.

Factors Supporting and Inhibiting the Role of CTL

The implementation of *Contextual Teaching and Learning* (CTL) in educational settings is supported by several interrelated factors. First, the alignment of learning materials with students' needs and real-life contexts has been shown to enhance motivation and active engagement in the learning process (Khairunnisak et al., 2020; Murnaka et al., 2018; Purba & Surya, 2020; Utami, 2023). In addition, learning activities that involve discussion, Problem Solving, and self-reflection contribute to the development of students' cognitive and social skills (Khotimah & Masduki, 2019; Nuraeni & Sukmaningthias, 2020). The role of competent teachers who are able to integrate technological media or local wisdom is also crucial for the successful implementation of CTL (Hutabarat et al., 2025; Megawati et al., 2024; Purwati et al., 2019; Salmani et al., 2020). Moreover, a supportive learning environment, along with learning facilities based on ICT and digital platforms such as Moodle, further strengthens the effectiveness of this approach (Amidi et al., 2025; Susanto et al., 2022).

Despite these strengths, several inhibiting factors often reduce the effectiveness of CTL in practice. A major barrier is the lack of teachers' understanding and skills in implementing CTL principles optimally (Khotimah & Masduki, 2019; Megawati et al., 2024; Murnaka et al., 2018; Muslihah & Suryaningrat, 2021). Other challenges include limited instructional time, an overloaded curriculum, and insufficient ICT facilities or culturally based learning media that are essential for contextual learning (Ahdhianto et al., 2020; Purba & Surya, 2020; Salmani et al., 2020; Wicaksono & Agustyaningrum, 2018). Differences in students' characteristics and initial abilities also pose challenges, particularly regarding variations in motivation, learning readiness, and resistance to new instructional methods, which may hinder active participation (Amidi et al., 2025; Buyung, 2015; Utami, 2023). Furthermore, poorly managed group discussions and challenges in monitoring activities on digital platforms remain issues that require further attention (Salma & Sumartini, 2022; Susanto et al., 2022).

Study Limitations

Several limitations of the studies on the implementation of CTL should be considered as critical notes. Most studies involved small and non-representative sample sizes, which limits the generalizability of their findings to broader populations (Bahri & Nasution, 2019; Megawati et al., 2024; Salmani et al., 2020; Setianto, 2020). The short duration of interventions reported in many studies also poses challenges in assessing the long-term impact of CTL implementation (Latipah & Afriansyah, 2018; Purwati et al., 2019; Utami, 2023). In addition, the reliance on teacher competence as a key determinant of success further restricts the breadth of the findings (Khotimah & Masduki, 2019; Priyadi & Yumiati, 2021; Salmani et al., 2020). Dependence on specific technological infrastructures and the use of non-experimental research designs in several studies also contribute to limitations in drawing robust causal conclusions (Amidi et al., 2025; Susanto et al., 2022).

Conclusion

Based on the review of 30 articles, the implementation of the Contextual Teaching and Learning (CTL) approach has been shown to positively enhance students' mathematical literacy skills from elementary to higher education levels. CTL effectively improves various components of mathematical literacy, including representation, Problem Solving, connection, reasoning, and mathematical communication within real-world contexts. The supporting factors of CTL include the contextualization of learning materials, the active role of teachers, the utilization of technology, and the integration of local wisdom. Conversely, inhibiting factors involve limited teacher competence, constrained instructional time, inadequate ICT infrastructure, and varying levels of student readiness. Common methodological limitations across studies include small sample sizes and short intervention durations. Overall, CTL is considered highly relevant for developing both the cognitive aspects of mathematical literacy and the affective dimensions of students' learning within contextual mathematics instruction.

References

Agustiani, S., & Jailani, J. (2023). Pengaruh Pendekatan Contextual Teaching And Learning Terhadap Hasil Belajar, Kemampuan Komunikasi Dan Berpikir Kritis Siswa. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *12*(2), 2253. https://doi.org/10.24127/ajpm.v12i2.6118

Agustyaningrum, N., & Widjajanti, D. B. (2013). Pengaruh Pendekatan CTL dengan Setting Kooperatif Tipe Kancing Gemerincing terhadap Kemampuan Komunikasi Matematis, Kepercayaan Diri, dan Prestasi Belajar Matematika Siswa SMP. *PYTHAGORAS Jurnal Pendidikan Matematika*, *8*(2), 171–180. https://doi.org/10.21831/pg.v8i2.8946

Ahdhianto, E., Marsigit, Haryanto, & Santi, N. N. (2020). The Effect Of Metacognitive-Based Contextual Learning Model On Fifth-Grade Students' Problem-Solving And Mathematical Communication Skills. *European Journal of Educational Research*, *9*(2), 753–764. https://doi.org/10.12973/eu-jer.9.2.753

Ahmad, M. (2019). Peningkatan Kemampuan Literasi Matematika Siswa Sekolah Menengah Pertama Melalui Pendekatan Kontekstual. *Jurnal Education and Development*, *7*(2), 103. https://doi.org/https://doi.org/10.37081/ed.v7i2.883

Amidi, Kartono, Mulyono, & Pudjiastuti, E. (2025). The Effectiveness of Contextual Teaching and Learning with Articulate Storyline in Improving Mathematical Literacy: A Perspective of High Self-Confidence Students. *Educational Process: International Journal*, *16*. https://doi.org/10.22521/edupij.2025.16.233

Bahri, S., & Nasution, A. S. (2019). Peningkatan Kemampuan Pemecahan Masalah Dan Kemandirian Belajar Siswa Melalui Pendekatan Contextual Teaching And Learning (CTL) Di Sekolah Menengah Pertama. *Prosiding Seminar Nasional & Exspo Hasil Penelitian Dan Pengabdian Masyarakat 2019*, 474–483. https://e-prosiding.umnaw.ac.id/index.php/penelitian/article/download/211/238

Buyung. (2015). Pengaruh Pendekatan Contextual Teaching And Learning (Ctl) Dengan Model Problem Based Learning (Pbl) Dan Persepsi Siswa Terhadap Mathematical Literacy Di Smp. *Jurnal Imiah Dikdaya*, *5*(2). https://doi.org/http://dx.doi.org/10.33087/dikdaya.v5i2.50

Chigbu, U. E., Atiku, S. O., & Du Plessis, C. C. (2023). The Science of Literature Reviews: Searching, Identifying, Selecting, and Synthesising. *Publications*, *11*(1), 2. https://doi.org/10.3390/publications11010002

Damayanti, R., & Afriansyah, E. A. (2018). Perbandingan Kemampuan Representasi Matematis Siswa antara Contextual Teaching and Learning dan Problem Based Learning. *JIPM (Jurnal Ilmiah Pendidikan Matematika)*, *7*(1), 30. https://doi.org/10.25273/jipm.v7i1.3078

Dewi, M. K. (2025). Systematic Literature Review: Penerapan Model Contextual Teaching and Learning sebagai Upaya Meningkatkan Kemampuan Pemecahan Masalah Matematis Siswa. *Cendikia: Jurnal Pendidikan Dan Pengajaran*, *3*(1), 362–373. https://jurnal.researchideas.org/index.php/cendikia/article/view/214

Dhani, M. I., & Rahayu, W. (2023). Literatur Review: Contextual Teaching and Learning (CTL) dalam Pembelajaran Matematika. *Jurnal Ilmiah IKIP Mataram*, *10*(2), 118–135. https://e-journal.undikma.ac.id/index.php/jiim/article/viewFile/9144/4904

Dhani, Muh. I., Ambarwati, L., & Sovia, A. (2025). Pengaruh Model Pembelajaran Contextual Teaching and Learning (CTL) terhadap Kemampuan Literasi Matematika ditinjau dari Kemampuan Awal Matematika Siswa di SMPN Duren Sawit Jakarta Timur. *JagoMIPA: Jurnal Pendidikan Matematika Dan IPA*, *5*(2), 370–382. https://doi.org/10.53299/jagomipa.v5i2.1442

Fatimah, Y., & Mashuri, M. (2024). Systematic Literature Review: Kemampuan Representasi Matematis Pada Pembelajaran Contextual Teaching and Learning. *PRISMA, Prosiding Seminar Nasional Matematika*, 808–813. https://proceeding.unnes.ac.id/prisma/article/view/3033

Firmansyah, A., Hasanuddin, H., & Nelson, Z. (2018). Pengaruh Model Pembelajaran Contextual Teaching and Learning terhadap Kemampuan Komunikasi Matematis Berdasarkan Pengetahuan Awal Siswa. *JURING (Journal for Research in Mathematics Learning)*, *1*(1), 01. https://doi.org/10.24014/juring.v1i1.4772

Hutabarat, D. S., Harahap, T. H., & Nasution, M. D. (2025). The Impact of Cooperative Learning and Contextual Teaching on Problem-Solving Skills and Student Responsibility in High School Mathematics. *Journal of English Language and Education*, *10*(2), 189–197. https://doi.org/10.31004/jele.v10i2.724

Kanthawat, C., Supap, W., & Klin-eam, C. (2019). The Development of Grade 11 Students' Mathematical Literacy on Sequences and Series Using Mathematical Modelling. *Journal of Physics: Conference Series*, *1157*, 032100. https://doi.org/10.1088/1742-6596/1157/3/032100

Khairunnisak, C., Hasbi, M., Mustika, A., & Elizar, E. (2020). Students' Mathematical Connection Ability In The Learning Employing Contextual Teaching And Learning. *Journal of Physics: Conference Series*, *1460*(1). https://doi.org/10.1088/1742-6596/1460/1/012028

Khamid, A., & Santosa, R. H. (2016). Keefektifan Pendekatan PBL dan CTL Ditinjau Dari Komunikasi Matematis Dan Motivasi Belajar Siswa SMP. *PYTHAGORAS: Jurnal Pendidikan Matematika*, *11*(2), 111. https://doi.org/10.21831/pg.v11i2.10660

Khotimah, R. P., & Masduki. (2019). Improving Reasoning Ability Through Contextual Teaching And Learning In Differential Equations. *Journal of Physics: Conference Series*, *1265*(1). https://doi.org/10.1088/1742-6596/1265/1/012017

Kurniawati, I., Yusnia, & Novianti Mandasari. (2023). Penerapan Model CTL Pada Mata Kuliah Konsep Dasar Geometri Dan Pengukuran Dalam Meningkatkan Literasi Matematika Mahasiswa. *Jurnal Penelitian Pembelajaran Matematika Sekolah (JP2MS)*, *7*(1), 60–67. https://doi.org/10.33369/jp2ms.7.1.60-67

Latipah, E. D. P., & Afriansyah, E. A. (2018). Analisis Kemampuan Koneksi Matematis Siswa Menggunakan Pendekatan Pembelajaran CTL dan RME. *Matematika*, *17*(1). https://doi.org/10.29313/jmtm.v17i1.3691

Laurens, T., Batlolona, F. A., Batlolona, J. R., & Leasa, M. (2017). How Does Realistic Mathematics Education (RME) Improve Students' Mathematics Cognitive Achievement? *EURASIA Journal of Mathematics, Science and Technology Education*, *14*(2). https://doi.org/10.12973/ejmste/76959

Megawati, P., Turmuzi, M., & Nurmawanti, I. (2024). Pengaruh Penggunaan Model CTL Berbasis Budaya Sasak Terhadap Literasi Matematika Siswa Kelas III SDN 20 Cakranegara Tahun Ajaran 2024. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *9*(2). http://journal.unpas.ac.id/index.php/pendas/article/view/16463

Miles, M. B., & Huberman, A. M. (1994). Qualitative Data Analysis: An Expanded Sourcebook. In *Thousand Oaks* (2nd ed.). SAGE Publications, Inc. https://books.google.co.id/books?id=U4lU_-wJ5QEC&printsec=frontcover&redir_esc=y#v=onepage&q&f=false

Munandar, H., & Panjaitan, D. J. (2023). Efektivitas Pendekatan Contextual Teaching And Learning (CTL) Ditinjau Dari Minat Dan Literasi Matematika. *Jurnal MathEducation Nusantara*, *6*(2), 177–187. https://doi.org/https://doi.org/10.32696/jmn.v6i2.310

Murnaka, N. P., Anggraini, B., Arumella Surgandini, dan, Matematika, P., & Surya Tangerang, S. (2018). Efektifitas Pembelajaran Dengan Pendekatan Contextual Teaching And Learning (CTL) Untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis. *Jurnal Derivat*, *5*(1), 1–8. https://doi.org/https://doi.org/10.31316/j.derivat.v5i1.144

Muslihah, N. N., & Suryaningrat, E. F. (2021). Model Pembelajaran Contextual Teaching and Learning terhadap Kemampuan Pemecahan Masalah Matematis. *Plusminus: Jurnal Pendidikan Matematika*, *1*(3), 553–564. https://doi.org/10.31980/plusminus.v1i3.963

MZ, Z. A., Supriyanto, D. P., Andriani, L., & Nurdin, E. (2021). The Effect Of Application Of Contextual Teaching And Learning Model On Mathematical Problem Solving Ability Based On Self Regulated Learning Of High School Students In Pekanbaru. *Journal of Physics: Conference Series*, *1776*(1), 012038. https://doi.org/10.1088/1742-6596/1776/1/012038

Nuraeni, Z., & Sukmaningthias, N. (2020). Using Geo-Gebra Assisted CTL Model to Increase the Student's Mathematical Representation. *4th Sriwijaya University Learning and Education International Conference (SULE-IC 2020)*, 588–593. https://doi.org/https://doi.org/10.2991/assehr.k.201230.167

Nurjannah, S., S., A., & Husniati, A. (2023). Pengaruh Pendekatan Pembelajaran Contextual Teaching and Learning Terhadap Kemampuan Pemecahan Masalah dan Hasil Belajar Matematika Pada Siswa Kelas V Gugus SDN 29 Campagaloe. *Jurnal Ilmiah Profesi Pendidikan*, *8*(3), 1869–1876. https://doi.org/10.29303/jipp.v8i3.1634

OECD. (2023). *PISA 2022 Results (Volume III): Creative Minds, Creative Schools*, *PISA*. OECD. https://doi.org/10.1787/dfe0bf9c-en

Pranata, N., Nindiasari, H., Fatah, A., Sultan, U., & Tirtayasa, A. (2020). Efektivitas Pendekatan Kontekstual Terhadap Kemampuan Literasi Matematis Siswa Smp Berbasis Karakter Dan Budaya Lokal. *WILANGAN: Jurnal Inovasi Dan Riset Pendidikan Matematika*, *1*(3). http://www.jurnal.untirta.ac.id/index.php/wilangan

Priyadi, H. G., & Yumiati. (2021). The Effect of Contextual Teaching and Learning (CTL) Model With Outdoor Approach Towards the Students' Ability of Mathematical Representation. In: Education Quarterly Reviews. *The Education Quarterly Reviews*, *4*(3), 441–450. https://doi.org/10.31014/aior.1993.04.03.352

Purba, G. I. D., & Surya, E. (2020). The Improving of Mathematical Understanding Ability and Positive Attitudes of Unimed FMIPA Students by Using the Contextual Teaching Learning (CTL) Approach. *Journal of Physics: Conference Series*, *1462*(1). https://doi.org/10.1088/1742-6596/1462/1/012019

Purwati, P., Marasabessy, F., & Damopolii, I. (2019). Enhancing Students Activity And Problem Solving Skill Through CTL-Based Local Wisdom Approach. *Journal of Physics: Conference Series*, *1321*(3). https://doi.org/10.1088/1742-6596/1321/3/032077

Pusmenjar. (2020). *AKM dan Implikasinya pada Pembelajaran*. Kementerian Pendidikan dan Kebudayaan.

Putri, C. Y., Hendriana, H., & Fitrianna, A. Y. (2024). Contextual Teaching and Learning: Upaya Optimalisasi Kemampuan Literasi Matematis. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *7*(5), 933–940. https://doi.org/https://doi.org/10.22460/jpmi.v7i5.25040

Rum, A. M., & Juandi, D. (2022). Students' Difficulties in Solving Mathematical Literacy Problem Level 3, Level 4 and Level 5. *International Society for Technology, Education, and Science*. https://files.eric.ed.gov/fulltext/ED630992.pdf

Rusmining, R., & Sawitri, R. (2022). Analysis of Student Errors in Solving Mathematical Literacy Problems Based on the Components of the Mathematical Literacy Process. *Unnes Journal of Mathematics Education*, *11*(2), 118–124. https://doi.org/10.15294/ujme.v11i2.51046

Rustam, A. (2018). Peningkatan Kemampuan Representasi Matematis Melalui Pembelajaran Kontekstual Siswa Kelas VIII SMP. *Buana Matematika: Jurnal Ilmiah Matematika Dan Pendidikan Matematika*, *8*(1). https://doi.org/https://doi.org/10.36456/buanamatematika.v8i1:.1517

Sachdeva, S., & Eggen, P.-O. (2021). Learners' Critical Thinking About Learning Mathematics. *International Electronic Journal of Mathematics Education*, *16*(3), em0644. https://doi.org/10.29333/iejme/11003

Salma, F. A., & Sumartini, T. S. (2022). Kemampuan Representasi Matematis Siswa antara yang Mendapatkan Pembelajaran Contextual Teaching and Learning dan Discovery Learning. *Plusminus: Jurnal Pendidikan Matematika*, *2*(2), 265–274. https://doi.org/https://doi.org/10.31980/plusminus.v2i2.1103

Salmani, S., Fauzan, A., Made Arnawa, I., Darmansyah, D., & Widada, W. (2020). The Impact of ICT-Based Contextual Mathematics Learning on Students' Problem-Solving Ability. *Proceedings of the 2nd International Conference Innovation in Education (ICoIE 2020)*, 376–381. https://doi.org/https://doi.org/10.2991/assehr.k.201209.252

Setianto, I. E. (2020). Kemampuan Representasi Matematis Siswa SMP melalui Pendekatan Pembelajaran RME dan CTL pada Sub Pokok Bahasan Kubus dan Balok. *Indonesian Journal of Mathematics and Natural Sciences Education*, *1*(3). http://mass.iain-jember.ac.id

Stacey, K. (2015). The Real World and the Mathematical World. In *Assessing Mathematical Literacy* (pp. 57–84). Springer International Publishing. https://doi.org/10.1007/978-3-319-10121-7_3

Sunaryo, P. R., Hutajulu, M., & Kadarisma, G. (2023). Systematic Literature Review: Analisis Kemampuan Berpikir Kritis Siswa Melalui Pembelajaran Kontekstual. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *6*(5), 1865–1872. https://doi.org/https://doi.org/10.22460/jpmi.v6i5.20448

Susanto, Y. R., Rochmad, R., & Wardono, W. (2022). The Evaluation of Mathematical Communication Skills with Moodle-assisted CTL Learning Model in Middle School. *Journal of Research and Educational Research Evaluation*, *11*(1), 2022–2056. http://journal.unnes.ac.id/sju/index.php/jere

Utami, N. D. (2023). Penerapan Pendekatan Kontekstual untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Siswa Sekolah Dasar. *Jurnal Pendidikan Guru Sekolah Dasar*, *1*(2), 1–9. https://doi.org/10.47134/pgsd.v1i2.134

Wicaksono, M. A., & Agustyaningrum, N. (2018). Efektifitas Pendekatan CTL Dan PBL Dengan Setting Kooperatif Tipe STAD Ditinjau Dari Kemampuan Literasi Matematis Siswa. *Cahaya Pendidikan*, *4*(1), 23–35.

Xiao, Y., & Watson, M. (2019). Guidance on Conducting a Systematic Literature Review. *Journal of Planning Education and Research*, *39*(1), 93–112. https://doi.org/10.1177/0739456X17723971

Yulinda, N., Irawati, R., & Gusrayani, D. (2016). Pengaruh Pendekatan Contextual Teaching and Learning (CTL) Terhadap Kemampuan Pemecahan Masalah Matematis Dan Kepercayaan Diri Siswa Pada Materi Volume Kubus Dan Balok. *Jurnal Pena Ilmiah*, *1*(1), 1051–1060. https://doi.org/https://doi.org/10.17509/jpi.v1i1.3024