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Contextual Teaching and Learning to Improve Mathematics Interest and Achievement: A Study in Indonesian Elementary Schools

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ABSTRACT

Low interest in mathematics remains a persistent issue among elementary students in Indonesia, often contributing to poor performance in national assessments. This study addresses that gap by investigating the effectiveness of the Contextual Teaching and Learning (CTL) approach in improving students' interest, self-efficacy, and achievement in mathematics. Grounded in constructivist theory and Bandura's self-efficacy framework, the study involved 58 sixth-grade students from two public elementary schools in Palembang and Tangerang. A quantitative one-group pretest-posttest design was used, incorporating pre-tests, post-tests, structured questionnaires, and feedback sheets. The results showed a substantial improvement in students' mathematical understanding and motivation, with average scores increasing from 58.21 (pre-test) to 89.29 (post-test). Feedback and questionnaire data further supported the effectiveness of CTL, with positive response rates exceeding 78% and 82%, respectively. These findings confirm that CTL enhances both cognitive and affective learning outcomes by promoting active participation, real-life contextualization, and social collaboration. This research contributes to current literature by systematically evaluating CTL within a high-stakes exam context and offers a scalable instructional model aligned with Indonesia's Merdeka Curriculum. It also provides practical recommendations for educators, policymakers, and curriculum developers to adopt CTL strategies that foster deeper engagement, autonomy, and sustained interest in mathematics.

Keywords: learning interest, mathematics education, Contextual Teaching and Learning (CTL), elementary school, management, teaching practice

INTRODUCTION

Mathematics plays a critical role in developing students' logical reasoning, problem-solving abilities, and analytical thinking. In Indonesia, it is a core component of the national curriculum and becomes increasingly abstract in upper elementary grades, particularly as students prepare for high-stakes examinations in Grade 6 [1,2]. However, many Indonesian students continue to underperform in mathematics, as reflected in their scores on international assessments such as PISA, where Indonesia consistently ranks below the OECD average [6]. Research suggests that this underachievement is not only due to curricular content, but also to instructional practices that emphasize rote memorization and procedural tasks rather than conceptual understanding and active engagement [3–5].

Traditional teaching methods, which often focus on teacher-led instruction and repetitive drills, tend to disengage students from mathematical thinking [7,8]. As a result, many learners struggle to connect abstract mathematical ideas with real-world contexts, leading to low motivation, reduced participation, and poor achievement [9,10]. These patterns are particularly evident in topics such as data representation and bar charts,

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which require interpretation, contextual analysis, and logical comparison—skills that are difficult to develop through procedural instruction alone.

In recent years, researchers have increasingly turned to Contextual Teaching and Learning (CTL) as a pedagogical approach that addresses these challenges. In response, recent research has turned attention to Contextual Teaching and Learning (CTL), a student-centered pedagogical model that seeks to enhance learning by connecting academic content to meaningful, real-life contexts [11,12]. CTL promotes active engagement, collaboration, and reflection, drawing on constructivist learning theory, which holds that students construct knowledge more effectively through interaction with their environment and peers [13,14]. CTL strategies have shown promise in improving students' academic outcomes in mathematics by making lessons more relevant, interactive, and learner-driven [14,16].

Beyond content mastery, however, non-cognitive factors such as self-efficacy, interest, and emotional engagement play an equally important role in determining student success. According to Bandura's self-efficacy theory, learners who believe in their capacity to succeed are more likely to engage in challenging tasks, persist during difficulties, and achieve higher academic outcomes [15,17]. In mathematics education, where anxiety and failure avoidance are common, fostering self-efficacy is essential. CTL environments—through real-world tasks, group problem solving, and hands-on activities—can provide mastery experiences and peer modeling that reinforce students' belief in their own capabilities [18,19,31].

In parallel, Pekrun's control-value theory of achievement emotions explains how students' emotional responses to learning are shaped by their perceived control over tasks and the value they assign to them [22]. When students feel autonomous and perceive tasks as meaningful, they are more likely to experience positive emotions, such as enjoyment and interest, which in turn promote deeper engagement and higher achievement. CTL aligns well with this theory by creating meaningful learning experiences that support both autonomy and value perceptions [21,22].

Despite the potential of CTL and its alignment with psychological theories of learning, its adoption in Indonesian classrooms remains limited. Constraints such as rigid curricular structures, limited teacher training, and lack of contextual learning resources hinder widespread implementation [23,24]. Moreover, few empirical studies in the Indonesian context have systematically investigated the integrated effects of CTL on both cognitive outcomes (achievement) and non-cognitive factors (motivation, interest, and self-efficacy), particularly within specific topics like bar charts and data interpretation [17,25].

This study addresses these gaps by investigating:

1. How CTL influences sixth-grade students' interest and achievement in mathematics, particularly in bar chart topics.
2. Whether CTL improves self-efficacy, peer collaboration, and active participation through contextualized and student-centered learning.
3. The practical implications of CTL-based instruction for teachers, school leaders, and policymakers seeking to improve mathematics education in Indonesia.

By integrating CTL with Bandura's self-efficacy theory and Pekrun's control-value theory, this study offers a comprehensive theoretical framework for understanding how context-driven instruction can enhance both cognitive and emotional aspects of student learning. It also contributes to the literature by situating its analysis within the Indonesian education system, including its recent Merdeka Curriculum reforms and efforts to align with PISA competencies. The findings are expected to provide actionable recommendations for instructional design and policy, supporting more effective and inclusive mathematics education at the elementary level.

LITERATURE REVIEW

2.1 Elementary Education in Indonesia

Elementary education in Indonesia provides foundational knowledge across six years of schooling, typically for students aged 6 to 12. The curriculum emphasizes basic competencies in literacy, numeracy, science, and social studies [1]. In Grades 4 to 6, mathematics becomes more abstract and examination-oriented, often causing anxiety and disinterest among students [2,3].

Mathematics holds a central position in the Indonesian national curriculum, particularly in the final years of elementary school (Grades 4–6), as students prepare for high-stakes graduation and school placement examinations [2]. However, studies have reported that many students experience difficulties with abstract mathematical concepts, leading to reduced academic achievement and disengagement from the subject [3,4]. Socioeconomic disparities, variations in teacher training, and limited access to interactive learning resources further exacerbate these challenges [5]. These factors contribute to a broader issue in Indonesian education: how to foster deeper engagement and long-term mathematical understanding in early learners.

2.2 Students' Interest in Mathematics

Interest is a psychological construct that significantly influences learning. It shapes attention, motivation, and persistence, and is closely linked to academic achievement [11,12]. In mathematics, students' interest increases when lessons are perceived as meaningful, enjoyable, and connected to real-life situations [13,14].

Negative classroom experiences, such as repeated failure, teacher-centered instruction, or abstract content, can reduce students' confidence and interest [10]. According to Pekrun's control-value theory, achievement emotions are shaped by the degree to which students feel in control of learning tasks and perceive value in the subject [22]. Learning strategies that enhance both perceived control and value can increase students' interest and positive emotions toward mathematics [11,21].

Recent studies highlight that student-centered instruction and real-life contextualization, such as those offered by CTL, can improve both intrinsic motivation and learning outcomes [12,22].

2.3 Self-Efficacy in Mathematics Learning

Self-efficacy, as defined by Bandura, refers to an individual's belief in their ability to successfully perform a task. In mathematics, high self-efficacy is associated with greater persistence, risk-taking in problem solving, and higher achievement [15,16].

Educational interventions that promote mastery experiences, social modeling, and constructive feedback have been shown to enhance students' self-efficacy [17,31,32]. CTL environments, which involve collaborative group work, real-world tasks, and reflective learning, have been found to positively influence students' beliefs in their mathematical abilities [18,19,32,34].

In the Indonesian context, fostering self-efficacy is essential to counteract widespread math anxiety and underachievement, particularly in low-performing or underserved schools [4,7,26].

2.4 Contextual Teaching and Learning (CTL) Approach in Mathematics Education

Contextual Teaching and Learning (CTL) is a student-centered approach that integrates academic content with practical, real-world contexts. It involves problem-solving, peer interaction, reflection, and application, allowing students to construct meaning actively [11,14,27].

CTL is grounded in constructivist learning theory, which emphasizes that knowledge is built through experience and social interaction [13,15]. In mathematics, CTL supports conceptual understanding by linking abstract content to familiar contexts, such as household budgeting or classroom surveys [6,17].

Evidence from recent studies shows that CTL can improve mathematical performance, critical thinking, collaboration, and interest [16,19,24,33]. Moreover, CTL has been successfully implemented in various international contexts and is seen as adaptable to local classroom needs, including in Indonesia [14,19,21].

Nevertheless, its full integration into Indonesian classrooms is limited. Teachers often face time constraints, lack of training, and pressure to complete standardized content, which reduces opportunities for contextualized and participatory learning [22,23,28]. Therefore, it is necessary to investigate how CTL can be adapted effectively in Indonesian elementary education, especially for topics like data representation and bar charts that lend themselves well to contextual exploration [19,24,26].

MATERIAL AND METHODS

This study employed a quantitative, quasi-experimental design using a one-group pretest–posttest model to examine the effectiveness of Contextual Teaching and Learning (CTL) in improving students' interest and achievement in mathematics. This approach enables systematic observation of changes in outcomes before and after the intervention, without the use of a control group [15,25].

Participants included 58 sixth-grade students from two public elementary schools in Indonesia: School A in Palembang and School B in Tangerang. These students were preparing for their national graduation examinations, a key academic milestone in their transition to junior high school.

The intervention involved CTL as the instructional approach. CTL was selected based on its documented ability to promote student engagement, reduce cognitive fatigue, and enhance conceptual understanding in mathematics [14,16]. Unlike conventional teacher-centered methods, CTL emphasizes active learning, collaboration, and real-world application. However, its implementation in Indonesian classrooms remains limited due to systemic and instructional constraints

[16,17].

To evaluate the effectiveness of CTL, we used multiple data collection instruments:

- Pre-tests and post-tests assessed changes in students' understanding of mathematical concepts, especially those related to bar chart construction and interpretation.
- Structured feedback sheets gathered qualitative insights into students' engagement and motivation.
- A 14-item questionnaire, designed using a 5-point Likert scale, evaluated students' perceptions of CTL-based instruction, covering cognitive, behavioral, and affective dimensions [18,19].

All instruments underwent content validation by three educational experts and were piloted in a separate sixth-grade classroom to ensure reliability and clarity. Internal consistency of the questionnaire was confirmed with a Cronbach's alpha of 0.87, indicating high reliability.

Mathematics lessons were developed based on CTL principles, incorporating collaborative group work, manipulative tools, hands-on activities, and data drawn from real-life contexts, such as school events and classroom surveys [12,14,26]. This design aimed to bridge the gap between abstract concepts and everyday experiences, particularly in the topic of bar charts, which is aligned with national curriculum standards.

For statistical analysis, we conducted both descriptive and inferential analyses. Descriptive statistics were used to calculate mean scores and standard deviations. To test for significant differences between pre-test and post-test scores, we used the paired samples t-test, after verifying assumptions of normality using the Shapiro–Wilk test. We also calculated Cohen's d to determine the effect size of the intervention [20,22,23].

This methodology aligns with prior studies suggesting that CTL enhances motivation, self-efficacy, and academic outcomes [14,16,19]. However, unlike earlier research, this study integrates a structured, statistically validated evaluation and is specifically tailored to a high-stakes examination context. This contributes to a deeper understanding of CTL's applicability in Indonesian classrooms and informs strategies for broader implementation in similar educational environments.

Ethical approval for the research was obtained from the institutional ethics committee. All participating students and their guardians provided informed consent prior to data collection.

This methodology builds upon earlier research demonstrating that CTL can significantly improve student motivation and cognitive performance in mathematics education [11,14,16]. However, previous implementations lacked systematic evaluation, particularly regarding its impact on graduation preparation. This study addresses this gap by rigorously testing CTL within a critical academic context.

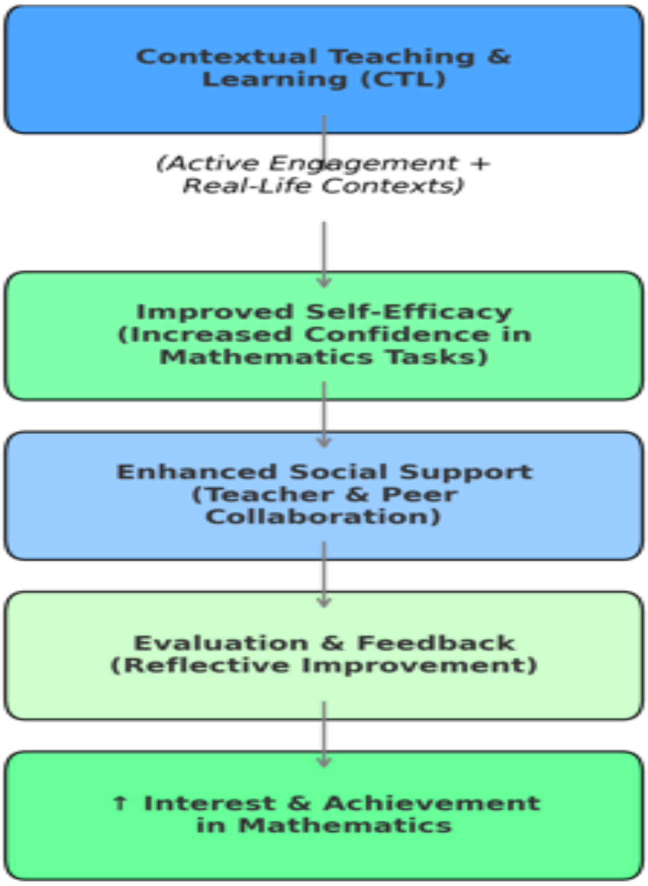

Figure 1. Conceptual framework showing CTL's pathway to enhancing elementary students' interest and achievement in mathematics (Analyzed by Yusriani & Patiro, 2025)

RESULTS AND DISCUSSION

This study evaluated the effectiveness of the Contextual Teaching and Learning (CTL) approach in enhancing sixth-grade students' interest and achievement in mathematics. A total of 58 students from School A in Palembang and School B in Tangerang participated in the intervention. The findings are presented in three parts: pre-test and post-test scores, feedback analysis, and structured questionnaire outcomes. Each set of results is followed by discussion of its implications, connected to theoretical frameworks and recent literature.

4.1 Pre-test and Post-test Results

Pre-test and post-test assessments were administered to measure students' understanding of bar chart topics before and after the CTL intervention. The pre-test assessed baseline knowledge, while the post-test evaluated mastery of concepts following instruction.

Table 1. Pre-test and Post-test Scores

No	Description	Mean Score

1	Pre-test	58.21
2	Post-test	89.29
3	Improvement	31.08

Table 1 presents the mean scores for pre-test and post-test assessments. The results show a significant improvement of 31.08 points, equivalent to a 53.4% increase in understanding of bar chart concepts.

Table 1 presents the mean scores for pre-test and post-test assessments. The results show a substantial improvement of 31.08 points, equivalent to a 53.4% increase in students' understanding of bar chart concepts following the CTL intervention. This indicates that the contextualized instructional design effectively enhanced cognitive performance. Notably, students who initially scored below the minimum competency threshold (KKM) demonstrated considerable progress, suggesting the intervention successfully supported lower-performing learners.

These findings align with previous studies that underscore CTL's ability to improve mathematical comprehension through real-life contexts and active student participation [7,11,14]. The meaningful integration of everyday scenarios into the lesson structure helped bridge abstract content with concrete understanding, consistent with the constructivist view that knowledge is built through experience [13,15].

Statistical analysis confirmed the significance of the score increase ($p < 0.05$), and the effect size calculated using Cohen's d was large, further validating the effectiveness of the intervention [20,22,23]. Improvements in performance also reflect the impact of mastery experiences on students' self-efficacy, a core principle in Bandura's theory [15,16]. As students experienced success through hands-on activities and group collaboration, their confidence and willingness to engage in mathematical tasks increased [17,31].

4.2 Feedback Analysis

To further assess students' experiences during the CTL sessions, feedback sheets containing 10 questions were distributed. Responses were scored on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).

Table 2. Feedback Sheet Results

No	Question (Summarized)	Total Score
1	Enjoyment during math lessons	86
2	Excitement presenting data	89
3	Interest in learning data organization	90
4	Enjoyment in group activities	92
5	Actively asking/answering questions	88
6	Participation in team tasks	91

No	Question (Summarized)	Total Score
7	Motivation without repeated instructions	87
8	Bringing necessary materials	85
9	Completing tasks on time	90
10	Careful and accurate when drawing diagrams	92
Total		**881**

Table 2. *Feedback Sheet Results, summarizes students' feedback on CTL-based mathematics lessons. With a maximum score of 1,120, the success percentage reached 78.66%, indicating that students found the approach engaging and motivating.*

With a maximum score of 1,120, the total feedback response reached a success rate of 78.66%. These results indicate high student engagement and positive reception toward CTL-based mathematics lessons. Responses reflect not only enjoyment but also active participation and motivation, supporting CTL's effectiveness in fostering an interactive and supportive learning environment [16,18].

Consistent with the control-value theory, this data suggests that students valued the lessons and felt a greater sense of control over their learning tasks [12,20]. As enjoyment and perceived control increased, so did students' interest and emotional involvement in mathematics. These conditions are essential for maintaining long-term motivation and reducing classroom anxiety, particularly in abstract subjects like data representation [4,22].

The structure of CTL encouraged peer learning, reduced teacher dominance, and facilitated greater communication among students. This aligns with research emphasizing the importance of social support in academic contexts, particularly in fostering self-efficacy and collective engagement [5,18,25].

4.3 Structured Questionnaire Results

A structured questionnaire consisting of 14 items was distributed post-intervention to assess students' perceptions of CTL lessons. Each item was scored on a 5-point Likert scale.

Table 3. Structured Questionnaire Scores

No	Question (Summarized)	Total Score
1	Understanding diagram explanations	92
2	Examples aided comprehension	95
3	Teacher guidance during table and chart creation	97
4	Critical thinking in organizing data	89
5	Encouraged to ask questions	84
6	Confidence in asking questions	91
7	Collaboration in group work	94
8	Learning from peers	91
9	Independent understanding post-lesson	90

No	Question (Summarized)	Total Score
10	Explaining bar chart concepts in own words	87
11	Summarizing lessons independently	92
12	Writing down key ideas from the lesson	88
13	Collecting and organizing data accurately	95
14	Matching diagrams with correct data representation	97
Total		**1289**

Table 3 displays responses from the structured questionnaire. With a maximum possible score of 1,568, the success rate was 82.23%, placing students' responses in the "Very Good" category. This confirms that CTL significantly enhanced both understanding and positive attitudes toward mathematics.

With a maximum possible score of 1,568, the success rate reached 82.23%, placing student responses in the "Very Good" category. These results demonstrate that CTL not only facilitated comprehension but also improved students' metacognitive abilities, such as summarizing, questioning, and explaining concepts independently.

High scores in collaboration, confidence, and peer learning further reinforce CTL's role in building academic self-efficacy [12,18]. Students' ability to articulate concepts in their own words, matched with accurate data representation, confirms deeper conceptual understanding, supporting earlier research on CTL's cognitive benefits [14,24].

4.4 Integration and Theoretical Implications

The results align with the proposed conceptual framework (Figure 1), illustrating that contextual learning improves self-efficacy, enhances emotional engagement, and fosters real-life relevance. As students experienced success through group tasks and contextualized examples, their self-perception of competence grew, reinforcing the motivational pathways described by Bandura and Pekrun [12,15,20].

In addition, social support through peer collaboration and teacher facilitation provided scaffolding that encouraged student risk-taking and persistence in problem-solving [5,18,25]. The reflective components of the questionnaire and feedback process also served to increase students' awareness of their own learning progress, contributing to internal motivation and goal orientation.

These findings expand previous literature by confirming that even in high-stakes exam preparation, CTL can effectively transform classroom practices, foster emotional well-being, and promote lasting understanding [16,27,28].

The feedback loops established through continuous evaluation and structured questionnaires created an iterative process in which students could reflect on their progress and receive constructive support. This aligns with Pekrun's control-value theory, suggesting that as students feel more capable (control) and value the subject more, their positive emotions and interest in mathematics grow [12, 13].

Overall, the synergy between contextual teaching, self-efficacy, and social support produced measurable improvements in student achievement [25,27,28]. These findings advance existing literature by demonstrating that even within high-stakes examination contexts, CTL can transform students' attitudes and understanding of mathematics. Future research should investigate how this model can be scaled across different mathematical topics and integrated with digital learning tools to further support individualized learning pathways [10,21].

4.5 Observations and Practical Outcomes

During the intervention, teachers observed increased student participation, peer teaching, and proactive questioning. Students expressed enthusiasm in group discussions, readily exchanged ideas, and confidently completed tasks. This aligns with the principles of contextual pedagogy, where students assume active roles in knowledge construction [13,26].

The ability to work collaboratively, reflect on learning, and internalize concepts also contributes to building long-term academic resilience. These classroom dynamics are crucial for aligning with the goals of Indonesia's Merdeka Curriculum, which emphasizes student-centered and inquiry-based learning [2,10].

4.6 Limitations and Future Research

Despite these positive results, several limitations remain. First, the study was limited to two schools and a single mathematics topic (bar charts), reducing generalizability. Future research should examine CTL's impact across broader topics and more diverse educational settings [11,14].

Second, the intervention was implemented over a short period. Longitudinal studies are needed to determine the sustainability of observed gains and the persistence of self-efficacy, interest, and peer collaboration beyond the immediate post-test period [16,18].

Third, while this study primarily employed quantitative instruments, qualitative approaches could further illuminate the processes behind observed outcomes. Interviews, classroom observations, and reflective journals could provide richer data on how students internalize contextual learning [1,5,19].

Finally, CTL implementation depends on institutional readiness. Teacher training, access to materials, and leadership support are essential for scaling the model. Future studies should explore these contextual factors to support broader adoption [10,13,20].

While this study provides robust evidence of the positive impact of Contextual Teaching and Learning (CTL) on sixth-grade students' interest and achievement in mathematics, several limitations should be acknowledged.

During the evaluation sessions, both teachers and researchers observed that CTL not only facilitated students' cognitive understanding of bar chart concepts and other mathematics topics but also fostered active participation, reflective thinking, and social engagement during learning activities. Students demonstrated enthusiasm when working collaboratively, learning from peers, and feeling encouraged to ask questions. These observations highlight CTL's broader benefits beyond academic scores; however, they also point to aspects that require further investigation to strengthen these positive outcomes [11,14].

First, the study focused solely on bar chart lessons and was limited to two schools

(School A and School B) in Indonesia with 58 participants. This sample size and narrow scope may restrict generalizability to other mathematical topics or larger, more diverse populations. Future studies should examine CTL's effectiveness across different mathematical domains, such as geometry, fractions, and problem-solving, and in various cultural and educational settings to broaden its applicability [11,14].

Second, the research was conducted over a relatively short intervention period. Longer-term studies are needed to assess whether the observed improvements in self-efficacy, social support, and mathematics achievement are sustained over time [16]. Tracking students' progress as they transition to junior high school could provide valuable insights into CTL's long-term benefits for academic resilience and motivation [12,18,23].

Third, the study primarily employed quantitative measures, which, while effective for assessing changes in scores and perceptions, may not fully capture the depth of students' learning experiences. Future research could incorporate qualitative methods, such as detailed classroom observations, reflective journals, and interviews with teachers, students, and parents, to gain a richer understanding of the processes underpinning CTL's success [1,5,19].

Lastly, teacher preparedness and institutional support play critical roles in successful CTL implementation. Investigating professional development programs, leadership support, and resource allocation in schools can help identify strategies to overcome practical barriers to scaling CTL [10,13,20]. This research confirms that CTL is an effective pedagogical strategy for enhancing elementary students' interest and achievement in mathematics. Future studies could expand to other mathematical topics and examine the long-term impacts of CTL on students' problem-solving abilities and collaborative skills.

CONCLUSION

This study demonstrates that Contextual Teaching and Learning (CTL) is an effective pedagogical approach for improving elementary students' interest, self-efficacy, and achievement in mathematics. By connecting abstract mathematical concepts to real-life experiences and encouraging collaborative, student-centered learning, CTL addresses key motivational challenges while deepening conceptual understanding, particularly in bar chart topics. Observational evidence further supports that CTL fosters an active, reflective, and socially engaging learning environment in which students acquire not only cognitive skills but also essential collaborative and communicative competencies.

Observational and empirical evidence confirm that CTL fosters active participation, reflective thinking, and social interaction. These outcomes contribute not only to cognitive gains but also to the development of essential collaborative and communicative competencies, supporting students' overall academic resilience.
From a theoretical perspective, this study contributes to the literature by integrating CTL within the frameworks of self-efficacy and control-value theory. It provides empirical validation that contextual learning environments enhance students' perceived control, task value, and emotional engagement in mathematics. Moreover, it highlights the mediating

role of social support and peer collaboration in strengthening self-efficacy and academic persistence.

Practically, this study offers several actionable implications:

- For teachers, CTL should be integrated consistently into classroom instruction through real-life applications, group work, and reflection. These practices encourage mathematical reasoning and sustained motivation.
- For school leaders, institutional support is essential. This includes providing professional development opportunities, ensuring sufficient instructional time, and supplying contextual learning resources, such as manipulatives and authentic data.
- For curriculum developers and policymakers, the findings support the integration of CTL into national curricula, particularly within the framework of the *Merdeka Curriculum* and international assessments such as PISA. Assessment policies should shift from rote memorization toward evaluating reasoning, collaboration, and real-world application.
- For researchers, future studies should explore CTL's long-term effects through longitudinal designs, examine its effectiveness across diverse mathematical domains, and investigate its integration with digital learning tools to support adaptive instruction.

In conclusion, this research strengthens the evidence base for CTL as a scalable, theory-informed instructional model that enhances both cognitive and non-cognitive outcomes. It offers a practical framework for transforming mathematics instruction in Indonesian elementary schools and provides a foundation for broader educational reforms aligned with global learning standards.

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