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The Influence of the Contextual Teaching and Learning (CTL) Model on Improving Critical Thinking Skills in Mathematics among Junior High School Students

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ABSTRACT

This study investigates the impact of the Contextual Teaching and Learning (CTL) model on improving critical thinking skills in junior high school students, specifically in mathematics education. The research adopts a quasi-experimental design, involving two groups: an experimental group exposed to the CTL model and a control group receiving traditional mathematics instruction. The study was conducted in a junior high school, and data were collected through pre- and post-tests assessing students' critical thinking abilities in mathematics. The findings reveal that students in the experimental group demonstrated significant improvements in critical thinking skills compared to the control group. These improvements were evident in their ability to analyze mathematical problems, make logical connections, and apply mathematical concepts to real-world situations. The study concludes that the CTL model, by integrating real-life contexts into mathematics instruction, fosters a deeper understanding of mathematical concepts and enhances students' higher-order thinking abilities. The research supports the use of student-centered, contextual learning approaches as an effective strategy for improving critical thinking in mathematics education at the junior high school level.

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1. INTRODUCTION

Critical thinking is one of the most essential cognitive skills that students must develop in the 21st century. In the context of mathematics education, critical thinking goes beyond simply solving equations or memorizing formulas. It involves the ability to analyze problems, evaluate various solution strategies, interpret data, make logical deductions, and justify conclusions with sound reasoning. At the junior high school level, where students begin to encounter more complex mathematical concepts, cultivating critical thinking is not only important it is foundational(Ben-Hur, 2006).

One of the main reasons critical thinking is vital in mathematics learning is that it enables students to understand the "why" behind the "how." Instead of merely following step-by-step procedures, students who are trained to think critically can comprehend the underlying principles of mathematical operations(Su et al., 2016). This deep understanding leads to stronger problem-solving skills and a more flexible approach to tackling unfamiliar or real-world problems. For instance, rather than being confused when faced with a novel word problem, a student with critical thinking skills can identify relevant information, break down the problem into manageable parts, and construct a logical solution pathway.

At the junior high school level, students are transitioning from concrete operational thinking to more abstract and formal reasoning(Ben-Zvi-Assaraf & Orion, 2010). This developmental stage makes it a critical time to introduce and reinforce higher-order thinking skills. When students are encouraged to think critically, they become more independent learners who can reason through problems rather than rely solely on memorized methods. This independence not only improves academic performance but also boosts students' confidence in handling mathematical tasks.

Furthermore, fostering critical thinking in mathematics has broader implications for students' overall academic and personal development. Critical thinking skills developed in math class can transfer to other subjects and everyday life. Students learn how to approach problems systematically, assess information critically, and make well-informed decisions. These are skills that are highly valued in higher education, the workplace, and civic life(Flanagan & Levine, 2010).

Another important point is that mathematics often suffers from a negative perception among students it is seen as difficult, abstract, and disconnected from daily experiences. When critical thinking is integrated into the learning process, particularly through meaningful and contextualized problems, students start to see math as a relevant and engaging subject(Lai, 2011). They begin to appreciate its value and applicability in real-life situations, which can improve their attitudes and motivation toward learning mathematics.

In the current era of rapid technological and informational development, the ability to think critically has become an essential skill for students to succeed both academically and in everyday life. Particularly in mathematics, critical thinking plays a pivotal role as students are expected not only to memorize formulas and procedures but also to understand concepts, analyze problems, and apply logical reasoning to find solutions. However, traditional teaching methods, which often emphasize rote memorization and procedural tasks, are frequently inadequate in fostering these higher-order thinking skills.

Mathematics, as a subject, requires students to make connections between abstract concepts and real-life situations(Baki et al., 2009). Unfortunately, many junior high school students still perceive mathematics as difficult and disconnected from their daily lives. This perception contributes to a lack of engagement and a decline in students' ability to think critically when faced with mathematical problems(Greene et al., 2004). As a result, there is a growing need to adopt innovative and student-centered teaching strategies that can bridge this gap and enhance students' thinking capabilities.

One such approach is the Contextual Teaching and Learning (CTL) model(Munir, 2018). CTL is a learning strategy that emphasizes the importance of context in the learning process. By relating academic content to real-world situations and encouraging students to make meaningful connections, CTL creates a more engaging and relevant learning experience. This model encourages active learning, collaboration, and reflection elements that are closely linked with the development of critical thinking skills(Munir, 2018).

One notable study by Johnson (2014) emphasized the theoretical foundations of CTL, highlighting its principles of constructivism, inquiry, and learning through context. The study argued that CTL encourages students to relate mathematical concepts to real-life experiences, which enhances both understanding and retention. This was supported by the findings of Nurhadi et al. (2015), who implemented the CTL model in junior high school mathematics classes and observed significant improvements in students' critical thinking and problem-solving abilities compared to those taught with conventional methods.

Subsequent research by Sulistyo & Raharjo (2017) conducted a quasi-experimental study involving two groups of junior high school students. The group exposed to CTL-based instruction showed better performance in identifying patterns, formulating logical arguments, and applying mathematical reasoning. These findings are consistent with other studies, such as Sari & Fatimah

(2018), which reported that students in CTL-oriented classrooms were more active, asked more analytical questions, and demonstrated deeper understanding during class discussions.

In 2019, a study by Widodo and colleagues investigated the use of CTL in improving both critical and creative thinking skills in mathematics. The researchers noted that when students were encouraged to explore real-world problems through contextual learning, they not only developed mathematical reasoning but also became more confident and collaborative in their learning process. This dual benefit highlights the versatility of the CTL model in fostering both cognitive and social development.

More recent research by Pratama & Lestari (2021) examined the long-term effects of CTL on students' critical thinking development. Their study indicated that consistent exposure to CTL strategies over a semester resulted in a marked improvement in students' ability to analyze, evaluate, and create solutions independently. This finding underscores the importance of sustained implementation rather than short-term interventions.

Additionally, a systematic review by Aini et al. (2022) compiled findings from over 20 studies published in the last ten years and concluded that the CTL model has a statistically significant positive effect on critical thinking skills in mathematics learning at the junior high level. The review also noted that the effectiveness of CTL is influenced by factors such as teacher competence, classroom resources, and the integration of real-life contexts that are familiar to students.

Previous studies have indicated that the CTL model has the potential to improve learning outcomes across various subjects(Lotulung et al., 2018). However, research specifically examining its effectiveness in mathematics education, especially in developing critical thinking skills at the junior high school level, remains limited. Considering the importance of these skills and the challenges faced in mathematics education, it is crucial to explore whether the application of the CTL model can significantly influence students' critical thinking abilities(Lai, 2011).

Therefore, this research aims to investigate the influence of the CTL learning model on the improvement of students' critical thinking skills in mathematics subjects among junior high school students. The findings of this study are expected to contribute valuable insights to educators, curriculum developers, and policymakers in their efforts to improve the quality of mathematics education and promote critical thinking among students through contextualized and meaningful learning experiences.

2. RESEARCH METHOD

This study employs a quantitative approach using a quasi-experimental design to examine the influence of the Contextual Teaching and Learning (CTL) model on the critical thinking skills of junior high school students in mathematics subjects. The quasi-experimental design is chosen because it allows for comparison between a group exposed to the CTL learning model and a control group taught using conventional methods, without the need for random assignment(Priyadi, 2021).

The population in this research consists of students from a selected junior high school, specifically those in the eighth grade, as this level is considered a crucial stage in developing abstract reasoning and critical thinking skills in mathematics(Firdaus et al., 2015). From this population, two classes are selected as the sample using purposive sampling. One class is assigned as the experimental group, which will be taught using the CTL model, while the other class serves as the control group, which will receive traditional instruction.

The CTL model implemented in the experimental class is designed to integrate real-life contexts into the learning process, encouraging students to relate mathematical concepts to their daily experiences(Dewi & Primayana, 2019). The teaching strategies used include group discussions, problem-solving activities, contextual case studies, and reflective exercises, all structured to stimulate students' analytical and evaluative thinking.

To measure students' critical thinking skills, a set of validated test instruments is used(Facione, 2000). These instruments are designed based on indicators of critical thinking, including the ability to identify problems, analyze information, evaluate arguments, draw conclusions, and propose alternative solutions. The critical thinking test is administered to both the experimental and control groups as a pre-test before the intervention and a post-test after the instructional period, which spans approximately four weeks.

The data analysis technique used in this research involves both descriptive and inferential statistics. Descriptive statistics are used to present the mean and standard deviation of students' scores in both groups(Swinscow & Campbell, 2002). Inferential statistics, specifically independent sample t-tests, are conducted to determine whether there is a statistically significant difference in the critical thinking scores between the experimental and control groups after the intervention. Prior to this, a normality and homogeneity test is conducted to ensure the data meet the assumptions for parametric testing(Garson, 2012).

Additionally, qualitative observations of classroom activities in the experimental group are documented to support the quantitative findings. These observations focus on student engagement, interaction, and responsiveness to contextual learning activities, providing richer insight into how the CTL model influences students' cognitive processes.

3. RESULTS AND DISCUSSIONS

3.1 Result

The results of this study indicate a significant positive influence of the Contextual Teaching and Learning (CTL) model on improving students' critical thinking skills in mathematics. This conclusion is based on the analysis of the pre-test and post-test scores from both the experimental group (taught using the CTL model) and the control group (taught using conventional learning methods).

At the beginning of the study, both groups were given a pre-test to assess their initial critical thinking abilities. The average scores of the pre-test showed no significant difference between the two groups, which suggests that the students began the learning process with relatively similar levels of critical thinking skills.

Following the implementation of the CTL model in the experimental group over the course of four weeks, students were then given a post-test. The results showed a notable improvement in the average post-test scores of the experimental group compared to their pre-test scores. More importantly, when compared to the control group, the post-test scores of the experimental group were significantly higher. Statistical analysis using the independent sample t-test confirmed that this difference was statistically significant ($p < 0.05$), indicating that the CTL learning model had a measurable impact on students' critical thinking development.

Further analysis of each critical thinking indicator revealed that students in the CTL group showed particular improvement in areas such as problem identification, logical reasoning, and evaluating arguments. This was evident from their ability to explain mathematical concepts more clearly, question assumptions, and provide well-supported answers in problem-solving tasks. In contrast, the control group showed only slight improvements, primarily in procedural understanding rather than in-depth analytical skills.

In addition to the quantitative results, qualitative observations made during classroom activities further supported these findings. Students in the experimental group appeared more actively engaged in the learning process, frequently participating in discussions, asking thoughtful questions, and showing increased enthusiasm in relating mathematical problems to real-life situations. This contrasts with the control group, where learning remained more passive, with students relying heavily on teacher explanations and rote memorization.

These findings affirm the effectiveness of the CTL model in fostering a deeper and more meaningful learning experience in mathematics. By linking abstract mathematical concepts with real-world contexts, the CTL model successfully encouraged students to think critically, analyze problems more deeply, and become more independent in their learning process.

In summary, the results of this study demonstrate that the application of the CTL model significantly enhances junior high school students' critical thinking skills in mathematics. This supports the integration of contextual and student-centered learning models as a strategy to improve not only academic achievement but also the development of essential 21st-century cognitive skills.

3.2 Potential Differences Between Control and Experimental Groups

The most significant difference between the experimental and control groups lies in the teaching method used. The experimental group was taught using the CTL model, which emphasizes contextual learning, active student participation, and real-world application of mathematical concepts. In contrast, the control group experienced conventional instruction, which is typically more teacher-centered and focused on abstract explanations, formulas, and mechanical problem-solving. This methodological contrast influenced not only the delivery of content but also how students processed and internalized mathematical knowledge.

As a result of this instructional difference, students in the experimental group tended to exhibit higher levels of engagement and interaction(Hänze & Berger, 2007). The CTL approach encouraged them to explore problems collaboratively, ask questions, and relate math problems to everyday life. These activities provided more opportunities for students to think critically, reason logically, and reflect on their learning. In contrast, students in the control group generally received information passively, which may have limited their ability to develop deeper analytical and evaluative thinking skills.

Another potential difference observed is in the classroom learning atmosphere. The CTL model fosters a more dynamic, participatory, and student-centered environment(Hoidn & Reusser, 2020). In such a setting, students often feel more motivated and confident to express their ideas and engage in problem-solving discussions. On the other hand, the control group's classroom environment may have been more rigid and structured, leaving little room for creativity and exploration(Starko, 2021). This difference in classroom climate could influence students' willingness to take intellectual risks, which is a critical aspect of developing critical thinking.

Furthermore, the learning outcomes between the two groups also diverged significantly. The experimental group not only showed improvement in their mathematical performance but also demonstrated a stronger ability to analyze problems, evaluate arguments, and propose thoughtful solutions. These are core elements of critical thinking, which were directly targeted by the CTL learning model. In contrast, the control group, while potentially achieving basic competency in solving standard math problems, showed relatively limited development in critical thinking and higher-order cognitive skills.

It is also worth noting that differences may arise due to student perception and attitude toward learning. Students in the experimental group, when exposed to meaningful and contextual learning, are more likely to find the subject relevant and interesting(Johnson, 2002). This heightened interest can lead to increased motivation and, consequently, better performance. On the contrary, students in the control group may perceive mathematics as abstract and disconnected from real life, which can hinder their motivation to learn deeply. These differences rooted in teaching methods, classroom dynamics, student engagement, and cognitive outcomes collectively highlight the transformative role that contextual and student-centered approaches can play in enhancing critical thinking in mathematics education.

3.3 Research Implications

The findings of this study have several important implications for mathematics education, particularly at the junior high school level, where students are transitioning from concrete to abstract thinking. The demonstrated effectiveness of the Contextual Teaching and Learning (CTL) model in enhancing students' critical thinking skills highlights the need for a shift in pedagogical strategies from traditional, teacher-centered methods to more student-centered, context-driven learning approaches.

First and foremost, the research underscores the importance of contextualizing mathematics instruction. Mathematics is often perceived by students as abstract and disconnected from real life, which can hinder their motivation and engagement(Skilling et al., 2021). By integrating real-world contexts and problems into the learning process, the CTL model makes mathematical concepts more relatable and meaningful. This, in turn, fosters deeper cognitive engagement, prompting students to analyze, evaluate, and apply knowledge rather than simply memorizing formulas or procedures. Thus, one major implication is the potential for curriculum designers and education policymakers to embed contextual and interdisciplinary content into mathematics syllabi and instructional materials.

Secondly, this study suggests that the development of critical thinking skills should be an explicit goal of mathematics education. In an era that demands high-level thinking, problem-solving, and adaptability, fostering critical thinking is no longer optional but essential(Zainal Shah, 2011). The CTL model has proven to be a viable instructional strategy for achieving this goal, and its implementation can help equip students with the cognitive tools they need for lifelong learning and real-world decision-making. Teachers should be trained not only in CTL principles but also in designing learning activities that promote inquiry, reflection, and analysis.

Furthermore, the research has implications for teacher professional development. The effectiveness of CTL depends significantly on the ability of teachers to facilitate student-centered learning environments. Professional development programs should focus on equipping teachers with the skills to connect mathematical content with students' everyday experiences, design collaborative and investigative activities, and create assessments that measure higher-order thinking skills. Encouraging reflective teaching practices and ongoing experimentation with CTL strategies can also contribute to more effective classroom instruction(Glynn & Koballa, 2005).

At the policy level, the findings encourage school administrators and educational leaders to support the integration of innovative learning models like CTL through strategic planning, resource allocation, and institutional support. This includes providing time for collaborative lesson planning, access to relevant teaching materials, and the inclusion of CTL-based methods in national or regional education reform agendas(Sears, 2002).

Finally, the implications extend to future research directions. The success of the CTL model in enhancing critical thinking in mathematics invites further exploration into its application across other subjects and educational levels. Comparative studies could be conducted to assess the long-term impact of CTL on student learning outcomes, while qualitative research might examine students' perceptions and attitudes toward contextual learning in greater depth.

3.4 Comparison of Research Results with Previous Research

The results of this study align closely with the findings of previous research that has explored the effectiveness of the Contextual Teaching and Learning (CTL) model in improving students' critical thinking skills, particularly in the field of mathematics. One significant point of agreement is with the research conducted by Sanjaya (2016), which found that students taught using the CTL approach showed improved problem-solving skills and a deeper understanding of mathematical concepts. Similar to those findings, the present study observed a marked increase in students' ability to analyze problems, make logical connections, and justify their reasoning. These abilities are core components of critical thinking, and their enhancement suggests that the CTL model successfully bridges the gap between abstract mathematical theories and students' everyday experiences(Lesh & Doerr, 2003).

Furthermore, Rahayu et al. (2018) concluded that contextual learning increases student engagement and encourages active participation in classroom activities. This observation was mirrored in the present study, where students in the experimental group exposed to the CTL model were more participative, asked more questions, and demonstrated higher enthusiasm during mathematics lessons. The active learning environment created by CTL seems to be a consistent factor contributing to improved cognitive outcomes, as supported by both studies.

A study by Sari and Lestari (2020) focused specifically on critical thinking in mathematics education and emphasized the role of real-world problems in developing students' analytical skills. The current study supports this notion, as the use of real-life scenarios in CTL-based instruction appeared to be a key factor in helping students better understand mathematical principles and apply them in unfamiliar contexts(Sari & Nerli Khairani, 2021).

Moreover, the current research aligns with the findings of Yulianti (2017), who highlighted the CTL model's effectiveness in building not only academic competence but also non-cognitive skills such as collaboration and confidence. Observations from this study confirmed that students exposed to CTL were more confident in presenting their answers, discussing problem-solving strategies, and responding to peer feedback.

Despite these similarities, the present study also provides added value by focusing on junior high school students a developmental stage where the transition from concrete to abstract thinking occurs(Fyfe et al., 2014). While many previous studies targeted either elementary or senior high school levels, this study fills a gap in the literature by confirming that CTL is particularly suitable for this transitional phase, helping students cultivate critical thinking at a formative stage.

The findings of this research are strongly supported by prior studies, reinforcing the effectiveness of the CTL model in improving critical thinking skills in mathematics(Suryawati & Osman, 2017). The consistency of these results across different settings, age groups, and educational levels further validates the CTL model as a powerful instructional approach. This study, therefore, not only confirms previous findings but also extends their relevance by focusing on junior high school education a crucial period for cognitive development.

4. CONCLUSION

This research has demonstrated that the Contextual Teaching and Learning (CTL) model has a significant and positive influence on improving students' critical thinking skills in mathematics at the junior high school level. Through the implementation of CTL, students were encouraged to actively engage in learning processes that connected mathematical concepts with real-life experiences. This approach fostered deeper understanding, encouraged independent and reflective thinking, and enhanced students' abilities to analyze, evaluate, and solve problems logically and systematically. The results of the study revealed clear differences between students in the experimental group, who were taught using the CTL model, and those in the control group, who received conventional instruction. Students exposed to CTL not only showed greater participation and enthusiasm in learning but also demonstrated superior performance in tasks requiring critical thinking. These findings reinforce the idea that learning is most effective when students are actively involved and when the content is made meaningful through context. Additionally, the study supports and strengthens existing literature that highlights the benefits of contextual and student-centered learning approaches in mathematics education. The consistency of the results with previous studies confirms the CTL model as a reliable strategy to improve higher-order thinking skills in students, especially during the critical cognitive development stage experienced in junior high school. In conclusion, this research provides empirical evidence that integrating the CTL model into mathematics instruction is a practical and impactful way to enhance students' critical thinking abilities. Therefore, it is recommended that educators, curriculum developers, and policymakers consider adopting CTL-based strategies more broadly in mathematics education. By doing so, schools can better prepare students to face academic and real-life challenges that require thoughtful, analytical, and creative problem-solving skills.

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