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The Effectiveness of the Contextual Teaching and Learning (CTL) Model in Improving Elementary School Students' Fraction Problem-Solving Ability

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ABSTRACT

This study aims to determine the effectiveness of the Contextual Teaching and Learning (CTL) model in improving the mathematical problem-solving skills of fourth-grade students at SDN Mekar Jaya 31 in Depok regarding fractions. The study employed a quantitative approach with a one-group pretest-posttest design. The study sample consisted of 32 fourth-grade students. Data collection techniques included tests, observations, and documentation. Tests were used to measure students' mathematical problem-solving skills before and after the implementation of the CTL model, while observations and documentation were used to support data on the implementation of the learning process. The results of the study indicate that the implementation of the CTL model was able to improve students' mathematical problem-solving skills in the topic of fractions. This was demonstrated by an increase in students' learning outcomes from the pretest to the posttest scores. The results of the paired-sample t-test also showed a significant difference between the scores before and after the intervention. These findings indicate that instruction using the CTL model is effective because it helps students understand the concept of fractions through real-life contexts, encourages active student engagement, and facilitates students' ability to develop problem-solving strategies. Thus, the CTL model can serve as an effective instructional alternative for improving elementary school students' mathematical problem-solving skills, particularly in the topic of fractions.

Keywords: CTL, Problem-Solving Skills, Mathematics.



ABSTRAK

Penelitian ini bertujuan untuk mengetahui efektivitas model Contextual Teaching and Learning (CTL) dalam meningkatkan kemampuan pemecahan masalah matematika pada materi pecahan siswa kelas IV SDN Mekar Jaya 31 Kota Depok. Penelitian menggunakan pendekatan kuantitatif dengan desain One Group Pretest-Posttest. Subjek penelitian berjumlah 32 siswa kelas IV. Teknik pengumpulan data meliputi tes, observasi, dan dokumentasi. Tes digunakan untuk mengukur kemampuan pemecahan masalah matematika siswa sebelum dan sesudah penerapan model CTL, sedangkan observasi dan dokumentasi digunakan untuk mendukung data pelaksanaan pembelajaran. Hasil penelitian menunjukkan bahwa penerapan model CTL mampu meningkatkan kemampuan pemecahan masalah matematika siswa pada materi pecahan. Hal ini ditunjukkan oleh adanya peningkatan hasil belajar siswa dari nilai pretest ke posttest. Hasil uji paired sample t-test juga menunjukkan adanya perbedaan yang signifikan antara nilai sebelum dan sesudah perlakuan. Temuan ini menunjukkan bahwa pembelajaran dengan model CTL efektif karena membantu siswa memahami konsep pecahan melalui konteks kehidupan nyata, mendorong keterlibatan aktif siswa, serta mempermudah siswa dalam menyusun strategi penyelesaian masalah. Dengan demikian, model CTL dapat menjadi salah satu alternatif pembelajaran yang efektif untuk meningkatkan kemampuan pemecahan masalah matematika siswa sekolah dasar, khususnya pada materi pecahan.

Kata Kunci: CTL, Pemecahan Masalah, Matematika.

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1. INTRODUCTION

Mathematics is a fundamental subject that plays a crucial role in developing students' logical, analytical, and systematic thinking skills from the elementary school level (Bognar & Horvat, 2025). Through mathematics learning, students are expected not only to perform calculations but also to understand concepts and apply them in everyday life. One of the essential competencies in mathematics learning is problem-solving ability, which serves as an indicator of students' success in understanding and applying mathematical concepts meaningfully (Wang et al., 2025).

However, in reality, elementary school students' mathematical problem-solving skills remain relatively low, particularly in the topic of fractions. Fraction material is known as one of the more complex topics because it involves understanding abstract concepts, symbolic representations, and interrelated arithmetic operation skills. Students often experience difficulties in understanding the meaning of fractions, determining the appropriate operations, and connecting word problems with suitable mathematical models. This condition causes students to tend to memorize procedures without deeply understanding the concepts, which ultimately impacts their low problem-solving abilities (Putri et al., 2025).

These problems were also found among fourth-grade students at SDN Mekar Jaya 31 in Depok. Based on preliminary observations, most students experienced difficulties in solving word problems related to fractions. Students tended to be confused in understanding the meaning

of the problems, were less precise in selecting arithmetic operations, and often made errors in the calculation process. Furthermore, the learning process that remained teacher-centered and lacked connections to real-life contexts made students less active and less motivated in learning mathematics.

One effort that can be made to address these problems is to implement a more contextual and meaningful learning model, such as the Contextual Teaching and Learning (CTL) model. The CTL model emphasizes the connection between learning materials and real-world situations, enabling students to build conceptual understanding through direct experience. In CTL learning, students are encouraged to be active, think critically, collaborate, and connect acquired knowledge with everyday life (Paudi & Ngaito, 2026). The application of the CTL model in mathematics learning, particularly in fraction material, is expected to help students understand concepts more concretely and deeply. By connecting fraction material with real contexts, students can more easily understand the meaning of fractions and develop strategies for solving problems. Additionally, learning that actively involves students can increase motivation and engagement in the learning process (Elysa & Lena, 2020).

Several previous studies have shown that the CTL model is effective in improving students' mathematical problem-solving abilities. This model can create more meaningful learning, increase student participation, and help students develop critical and creative thinking skills. Research conducted at SD N 1 Ujungpandan showed that students' mathematical problem-solving ability increased from 38% in the pre-cycle to 71% in cycle I and reached 100% in cycle II (Jannah et al., 2023).

Furthermore, research on the influence of the CTL model on fraction learning outcomes at State Elementary School 1 Kamarian demonstrated that the average increase in the high category was 71%, medium 48%, and low 29% (Misqa et al, 2024). The increase was due to the effective use of contextual models, where with contextual learning students could relate the real world to mathematical problems. The development of CTL-based student worksheets integrated with local culture has also been shown to be effective in improving fifth-grade students' understanding of fractional operations (Yuliandari et al., 2025). The integration of CTL strategies and local cultural content, supported by colorful visuals and contextual examples, created a more interactive and meaningful learning experience.

Studies have also revealed that the CTL approach can improve learning outcomes using fractions in problem-solving, particularly in multiplication and division of fractions (Misqa et al, 2024). The CTL model helps students connect context and strategy when solving mathematical problems (Rahman et al., 2023). Despite these positive findings, there remains a gap in the literature regarding the specific application of CTL to fraction problem-solving in fourth-grade elementary school classrooms in the Indonesian context, particularly in urban settings like Depok. Most existing studies have been conducted in different grade levels or with different mathematical topics. Therefore, this study addresses this gap by examining the effectiveness of CTL in improving fourth-grade students' fraction problem-solving skills at SDN Mekar Jaya 31.

The novelty of this research lies in its focus on the integration of CTL's seven components—constructivism, inquiry, questioning, learning community, modeling, reflection, and authentic assessment—in a systematically designed two-cycle classroom action research framework specifically tailored to fraction problem-solving in an urban elementary school setting (Siradjang & Paputungan, 2025; Riza et al., 2024). Based on the above explanation, research is needed to determine the effectiveness of the Contextual Teaching and Learning (CTL) model in improving mathematical problem-solving skills in fraction material. This research will be conducted on fourth-grade students at SDN Mekar Jaya 31 in Depok with a total of 32 subjects. The results of this study are expected to contribute to the development of more effective and meaningful mathematics learning strategies, particularly in improving students' problem-solving abilities in fraction material.

2. RESEARCH METHODS

This study employed a quantitative approach with a one-group pretest-posttest design. This design was chosen to measure the effectiveness of the CTL model by comparing students' mathematical problem-solving abilities before and after the intervention (Syah et al., 2023). The research was conducted at SDN Mekar Jaya 31 in Depok, with the research subjects consisting of all fourth-grade students, totaling 32 students. The selection of this school was based on preliminary observations indicating low problem-solving abilities among students in fraction material.

The research procedure followed the Classroom Action Research (CAR) model adapted from Kemmis and McTaggart, which consists of four stages: (1) planning, (2) action implementation, (3) observation, and (4) reflection (Syah et al., 2023). The research was conducted in two cycles, with each cycle consisting of two learning meetings. In the planning stage, the researcher prepared learning tools including teaching modules, student worksheets (LKPD), learning media, problem-solving ability test instruments, and observation sheets for teacher and student activities (Muchtar et al., 2023).

The action implementation stage involved applying the CTL model in mathematics learning. The learning process was designed to connect fraction material with real-life situations familiar to students, such as food sharing, buying and selling activities, and simple measurements. During the learning process, students worked in groups, engaged in discussions, solved contextual problems, and presented their work. The teacher acted as a facilitator who guided students in connecting mathematical concepts with real situations (Siradjang & Paputungan, 2025).

The observation stage was conducted throughout the learning process. Observations aimed to determine student activities, student engagement in learning, and the implementation of the CTL model. Observations were conducted using observation sheets that had been previously prepared by the researcher and observers (Hardiningsih et al., 2023). The reflection stage was conducted at the end of each cycle to evaluate the implementation of the actions taken. Reflection results were used as the basis for improving learning in the next cycle (Muchtar et al., 2023).

Data collection techniques included tests, observations, and documentation. Tests were used to measure students' mathematical problem-solving abilities in fraction material. Tests were given at the end of each cycle in the form of essay questions based on problem-solving ability indicators: understanding the problem, planning the solution, implementing the solution, and re-examining the results (Fauzi et al., 2023). Observations were used to observe student activities and the implementation of CTL learning, while documentation was used to complement research data in the form of activity photographs and other supporting documents.

The research instruments consisted of problem-solving ability test questions and observation sheets. Before use, the test instruments were tested for validity and reliability to ensure the feasibility of the research instruments. Data analysis was conducted using descriptive quantitative and qualitative techniques. Quantitative data were obtained from the results of students' problem-solving ability tests, analyzed using average scores and the percentage of students' learning completeness in each cycle (Hardiningsih et al., 2023). Meanwhile, qualitative data were obtained from observations of student activities and reflection notes during the learning process. The research success indicator was determined when at least 80% of students achieved scores above the Minimum Completeness Criteria (KKM) set by the school, and there was an increase in student activity and problem-solving ability in each cycle (Hardiningsih et al., 2023).

Table 1. Research Design and Data Collection

Stage	Activity	Data Collected	Instrument
Pre-Cycle	Pretest administration	Initial problem-solving ability	Problem-solving test
Cycle I	CTL implementation + Posttest I	Problem-solving ability after Cycle I	Problem-solving test, observation sheets
Cycle II	Revised CTL implementation + Posttest II	Problem-solving ability after Cycle II	Problem-solving test, observation sheets
Throughout	Observation & Documentation	Student activities, learning process	Observation sheets, camera

3. RESULTS AND FINDINGS

This classroom action research was conducted in two cycles on fourth-grade students at SDN Mekar Jaya 31 by applying the Contextual Teaching and Learning (CTL) model to fraction material. Each cycle consisted of planning, action implementation, observation, and reflection stages. The research aimed to improve students' mathematical problem-solving abilities. Before the action was implemented, the researcher administered a pretest to determine students' initial ability in solving fraction problem-solving questions. The pretest results showed that the average student score was 58.4, with a learning completeness percentage of only 34%. This low initial score indicated that students faced significant difficulties in understanding fraction concepts and applying them to problem-solving situations. Most students struggled with understanding word problems, identifying known and unknown information, and determining appropriate solution strategies (Putri et al., 2025). After implementing the CTL model in Cycle I, students were given

a posttest to determine the improvement in mathematical problem-solving abilities. The results showed an increase in student scores from the pretest to the posttest. The average score in Cycle I increased to 71.2, with a learning completeness percentage of 65%. This improvement indicated that the CTL model began to positively impact students' understanding and problem-solving skills, although it had not yet reached the predetermined success indicator of 80% (Samigaluh, 2023).

In Cycle II, after implementing improvements based on the reflection from Cycle I, the average score increased again to 84.6, with a learning completeness percentage reaching 87%. This result exceeded the research success indicator, demonstrating that the CTL model, when implemented with appropriate improvements, effectively improved students' mathematical problem-solving abilities in fraction material (Edita et al., 2026).

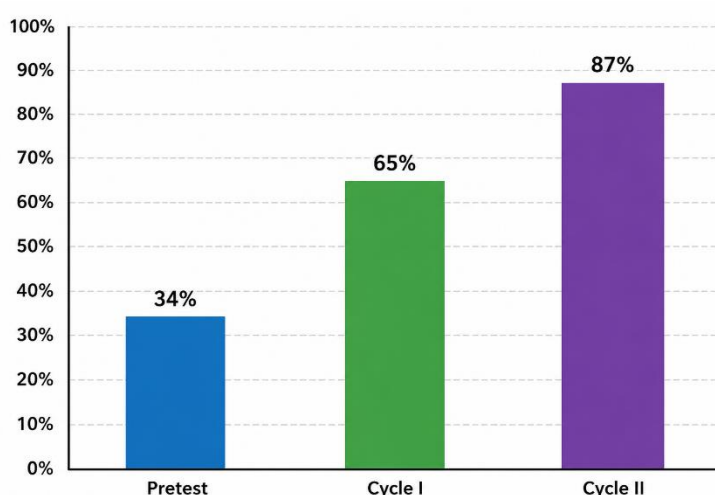


Figure 1. Student Learning Outcomes Across Research Stages

Cycle I Description

In the planning stage of Cycle I, the researcher prepared teaching modules, student worksheets (LKPD), learning media, and observation instruments in accordance with the CTL model steps. The learning was designed to connect fraction material with students' daily lives. Examples close to students' lives were prepared, such as food sharing and simple buying and selling activities, to make it easier for students to understand the meaning of fractions (Siradjang & Paputungan, 2025).

The implementation of the action in Cycle I was the initial stage of applying the CTL model. The teacher presented examples close to students' lives, enabling students to more easily understand the meaning of fractions. Subsequently, students were divided into groups to discuss the contextual problems that had been prepared. Through these activities, students were trained to understand problems, determine solution steps, and present their discussion results in front of the class. The process showed that learning began to be student-centered, while the teacher acted as a facilitator guiding the learning activities (Muchtar et al., 2023).

Observation results in Cycle I showed positive changes in student learning activities. Compared to the initial condition, students began to be more active in following the learning, paying attention to the teacher's explanations, and participating in group discussions. The application of CTL appeared to create a more lively learning atmosphere because students not only listened to explanations but were also directly involved in problem-solving (Elysa & Lena, 2020).

However, the implementation of Cycle I had not yet run optimally. Some students still experienced difficulties in understanding word problems, especially in identifying known and unknown information. Additionally, some students had not been able to determine solution strategies appropriately, so they still needed teacher guidance in solving problem-solving questions (Fauzi et al., 2023). This was reflected in the posttest results, where the completeness percentage only reached 65%, still below the 80% target (Samigaluh, 2023).

Based on the reflection results, several aspects needed improvement in the next learning implementation. The teacher needed to provide more intensive guidance to students who were still struggling, especially in understanding word problems and formulating problem-solving steps. Furthermore, the teacher needed to increase the involvement of all students in group discussions so that no students remained passive. The use of more interesting learning media and examples closer to students' experiences also became an important consideration for improving learning effectiveness in the next cycle (Mughtar et al., 2023).

Cycle II Description

In Cycle II, the researcher improved the learning process based on the reflection results from Cycle I. The teacher used more interesting learning media, provided contextual example questions closer to students' lives, and directed group work more effectively. Learning planning was rearranged by paying attention to students' needs, especially in improving understanding of word problems and problem-solving steps (Hardiningsih et al., 2023).

The implementation of CTL learning in Cycle II went better compared to Cycle I. The teacher not only delivered material and gave group assignments but also guided students more intensively at each stage of problem-solving. Students were directed to understand the content of the questions, determine the right strategy, perform fraction arithmetic operations, and re-examine the answers they had obtained (Rahman et al., 2023). Group discussion activities also ran more effectively because the teacher more actively monitored student collaboration and ensured each group member was involved in the learning process (Riza et al., 2024).

Observation results showed a real increase in student learning activities in Cycle II. Students appeared more active in asking questions, answering questions, expressing opinions, and collaborating in groups. Students' self-confidence also increased, especially when presenting discussion results in front of the class. Compared to Cycle I, students in Cycle II appeared more capable of understanding questions, determining solution steps, and solving fraction arithmetic operations correctly (Edita et al., 2026).

The improvement in the learning process directly affected student learning outcomes. The average posttest score in Cycle II increased to 84.6, higher than the Cycle I average of 71.2. The

learning completeness percentage also rose to 87%, thus exceeding the research success indicator of more than 80% of students achieving scores above the KKM (Hardiningsih et al., 2023). This result showed that the application of the CTL model accompanied by improvements in learning strategies was able to significantly improve students' mathematical problem-solving abilities (Jannah et al., 2023). Overall, the success in Cycle II confirmed that the CTL model was effective when applied to fraction material learning in elementary school. Learning that connected mathematical concepts with real experiences made it easier for students to understand material that was previously considered abstract. Furthermore, an active and student-centered learning atmosphere was able to increase motivation, participation, and problem-solving abilities (Elysa & Lena, 2020). With the achievement of the success indicator in Cycle II, this classroom action research was declared successful (Syah et al., 2023).

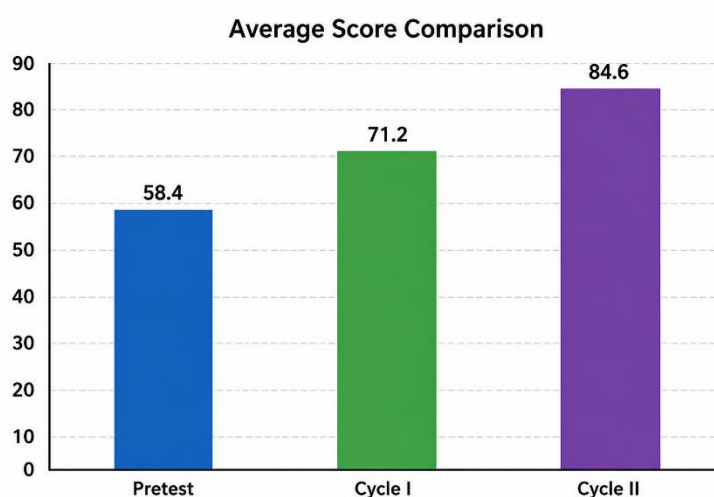


Figure 2. Comparison of Pretest, Cycle I, and Cycle II Results

Discussion

The findings of this study demonstrate that the application of the Contextual Teaching and Learning (CTL) model significantly improved fourth-grade students' mathematical problem-solving abilities in fraction material. The increase in average scores from 58.4 in the pretest to 71.2 in Cycle I and 84.6 in Cycle II indicates a progressive improvement in student learning outcomes. This finding aligns with previous research conducted at SD N 1 Ujungpandan, where students' mathematical problem-solving ability increased from 38% in the pre-cycle to 71% in Cycle I and reached 100% in Cycle II (Jannah et al., 2023).

The effectiveness of the CTL model can be attributed to its core principle of connecting learning materials with real-world contexts. When students can relate fraction concepts to their daily experiences—such as sharing food, shopping, or measuring—the abstract nature of fractions becomes more concrete and understandable. This is consistent with the constructivist foundation of CTL, which emphasizes that students build their own understanding through meaningful experiences. As noted by Siradjang & Papatungan (n.d.), the CTL approach

encourages students to discover and construct concepts themselves through learning experiences rather than passively receiving information.

The seven components of CTL—constructivism, inquiry, questioning, learning community, modeling, reflection, and authentic assessment—were systematically implemented throughout the two cycles (Riza et al., 2024). The constructivism component was evident when students built their understanding of fractions through hands-on activities and group discussions. The inquiry component encouraged students to ask questions and explore fraction concepts independently. The questioning component facilitated deeper thinking as students and teachers engaged in dialogue about problem-solving strategies.

The learning community component was particularly impactful in this study. Students worked in groups to discuss contextual problems, share ideas, and learn from one another. This collaborative approach not only improved understanding but also developed social skills and increased student engagement. Research by Riza et al. (2024) confirms that CTL demands collaborative activities and connections with the real world for successful learning in elementary schools.

The modeling component was demonstrated when the teacher showed examples of how to solve fraction problems using real-life contexts. Students observed the teacher's problem-solving strategies and then applied similar approaches to their own work. The reflection component allowed students to evaluate their understanding and identify areas needing improvement. Finally, authentic assessment was used to evaluate students' ability to apply fraction concepts in real-world situations (Siradjang & Paputungan, 2025).

The improvement from Cycle I to Cycle II highlights the importance of reflective practice in classroom action research. The reflection stage at the end of Cycle I identified several weaknesses: some students still struggled with word problems, group discussions were not optimally inclusive, and learning media needed to be more engaging. These findings are consistent with research by Samigaluh (2023), which found that initial achievement in Cycle I tends to be in the sufficient or low category, then increases after improvement actions in the following cycle.

In Cycle II, the teacher provided more intensive guidance, used more interesting media, and ensured all students participated actively in group discussions. These improvements resulted in a dramatic increase in learning completeness from 65% in Cycle I to 87% in Cycle II. This pattern mirrors findings from Edita et al. (2026), where mathematics learning outcomes increased from 57.69% in Cycle I to 80.76% in Cycle II, along with an increase in student activity scores from low to good categories.

The significant improvement in students' ability to solve fraction word problems can be attributed to CTL's emphasis on connecting mathematical concepts with meaningful contexts. Research by Putri et al. (2025) identified that students often struggle with fraction concepts because they are taught abstractly without real-world connections. CTL addresses this by providing concrete, relatable examples that make fractions more accessible. As noted by

Pradinar (2026), fraction concepts are more easily understood when connected to real experiences, concrete media, and group activities.

The development of problem-solving strategies was another key outcome of this study. Students learned to follow the systematic problem-solving steps: understanding the problem, planning the solution, implementing the solution, and re-examining the results. This aligns with research by Rahman et al. (2023), which found that CTL helps students connect context and strategy when solving mathematical problems. The CTL model effectively addresses the common weakness identified by Fauzi et al. (2023), where the weakest indicator in fraction problem-solving was re-examining answers (44%).

Student engagement and motivation also increased significantly throughout the study. Observations showed that students became more active in asking questions, expressing opinions, and participating in discussions. This finding is consistent with research by Elysa & Lena (2020), which found that learning involving active student participation can increase motivation and engagement in the learning process. The contextual nature of CTL makes learning more relevant and interesting for students, reducing the perception that mathematics is abstract and difficult.

The success of CTL in this study also supports broader findings in the literature regarding its effectiveness in elementary mathematics education. Research by Ajmain (2020) found that CTL tends to increase engagement, motivation, and problem-solving ability when tasks are meaningfully connected to everyday life. Similarly, studies by Muchtar et al. (2023) and Hardiningsih et al. (2023) confirmed that CTL improves conceptual understanding of fractions and helps students connect context and strategy when solving mathematical problems. The use of CTL-based student worksheets in this study also contributed to the positive outcomes. The worksheets were designed with contextual problems that students could relate to their daily experiences. This finding aligns with research by Yuliandari et al. (2025), which demonstrated that CTL-based worksheets integrated with local culture were effective in improving fifth-grade students' understanding of fractional operations. The development of CTL-based manipulatives has also been shown to facilitate conceptual understanding of fractions.

The findings of this study have important implications for mathematics education in elementary schools. First, they confirm that CTL is an effective instructional model for teaching fractions, a topic that has traditionally been challenging for students. Second, they demonstrate the value of classroom action research as a method for improving teaching practice through systematic reflection and iterative improvement. Third, they highlight the importance of connecting mathematical concepts to students' real-world experiences to make learning more meaningful and engaging.

Several factors contributed to the successful implementation of CTL in this study. Teacher readiness was crucial, as the teacher needed to skillfully facilitate student-centered learning and connect fraction concepts to relevant contexts. The use of appropriate media and teaching materials also played an important role. As noted by Panjaitan et al. (2023), the effectiveness of CTL is influenced by teacher readiness, media, class size, and technology. The relatively small class size of 32 students allowed for more individualized attention and effective group work.

The two-cycle design of this research was particularly effective because it allowed for continuous improvement. The reflection stage in each cycle provided valuable insights into what was working and what needed adjustment. This iterative approach ensured that the CTL model was implemented with increasing fidelity and effectiveness. Research by Syah et al. (2023) similarly found that the Kemmis and McTaggart model, with its four stages of planning, action, observation, and reflection, is effective for improving mathematical problem-solving ability.

The improvement in students' ability to re-examine their answers is particularly noteworthy. This was the weakest indicator in previous studies (Fauzi et al., 2023), but in this research, students increasingly demonstrated the habit of checking their work. The CTL model's emphasis on reflection and authentic assessment likely contributed to this improvement. Students learned to evaluate their own problem-solving processes and identify areas for improvement.

The success of this study also suggests that CTL can be effectively integrated with the existing elementary mathematics curriculum. The model does not require completely new content but rather a different approach to presenting existing content in more meaningful, contextual ways. This makes CTL a practical and feasible instructional strategy for teachers to adopt. The CTL model is particularly relevant for the independent curriculum currently being implemented in Indonesia, which emphasizes meaningful learning experiences (Bognar & Horvat, 2025).

However, the study also revealed some challenges in implementing CTL. Some students initially struggled with the more active, student-centered approach because they were accustomed to passive, teacher-centered learning. This required additional effort from the teacher to build students' confidence and participation skills. Time management was also a challenge, as CTL activities such as group discussions and presentations require more time than traditional lectures. These challenges highlight the need for adequate teacher training and support when implementing CTL (Wang et al., 2025).

Finally, the findings of this study contribute to the growing body of evidence supporting CTL as an effective instructional model for elementary mathematics. By connecting abstract mathematical concepts to students' real-world experiences, CTL makes learning more meaningful, engaging, and effective. The significant improvement in students' fraction problem-solving abilities in this study provides compelling evidence that CTL should be considered a valuable alternative for mathematics instruction in elementary schools (Hellstrand, 2025).

5. CONCLUSION AND SUGGESTIONS

Based on the classroom action research conducted over two cycles, it can be concluded that the application of the Contextual Teaching and Learning (CTL) model effectively improved the mathematical problem-solving abilities of fourth-grade students at SDN Mekar Jaya 31 in fraction material. The improvement in students' problem-solving abilities was evident from the test results in each cycle, which showed an increase in student learning completeness from 34% in the pretest to 65% in Cycle I and 87% in Cycle II. Additionally, student learning activities

also improved, with students becoming more active in discussions, asking questions, collaborating, and expressing opinions during the learning process. The results confirmed a significant difference between pretest and posttest scores, indicating that the intervention had a meaningful impact.

The application of the CTL model helped students understand fraction concepts more concretely by connecting the material to everyday life. Through contextual learning experiences, group discussions, and authentic problem-solving activities, students developed better strategies for understanding problems, planning solutions, implementing calculations, and re-examining their answers. These findings confirm that CTL can serve as an effective and meaningful alternative learning model for improving elementary school students' mathematical problem-solving abilities, particularly in fraction material. Future research is recommended to explore the application of CTL in other mathematical topics and grade levels, as well as to investigate the long-term retention of problem-solving skills developed through CTL-based instruction.

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