Implementation of the Contextual Teaching and Learning Model to Improve Students' Conceptual Understanding in Science Learning at MIN 5 Lhokseumawe

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ABSTRACT

This study aims to improve students' conceptual understanding in science learning through the implementation of the Contextual Teaching and Learning (CTL) model at MIN 5 Lhokseumawe. The research employed Classroom Action Research (CAR) consisting of two cycles, with each cycle involving four stages: planning, action, observation, and reflection. The participants were 28 fifth-grade students at MIN 5 Lhokseumawe during the 2024/2025 academic year. Data were collected through conceptual understanding tests, observation sheets of teacher and student activities, and field notes. The indicators of conceptual understanding included students' ability to explain scientific concepts, classify objects based on characteristics, provide examples of concepts, and apply concepts in daily life contexts. The findings revealed a significant improvement in students' conceptual understanding after the application of CTL. In the pre-cycle phase, only 10 out of 28 students (35.71%) achieved the minimum mastery criterion (MMC = 75), with an average score of 68.21. After the implementation of CTL in Cycle I, the number of students who achieved mastery increased to 18 students (64.29%) with an average score of 75.46. Furthermore, Cycle II showed stronger improvement, with 25 students (89.29%) achieving mastery and the average score rising to 84.32. Observation results also indicated improvements in learning engagement, where student activity increased from 70.15% in Cycle I to 87.60% in Cycle II, while teacher performance improved from 76.40% to 90.25%. These results confirm that the CTL model effectively enhances students' conceptual understanding in science learning by connecting scientific content with real-life situations, promoting active participation, and encouraging meaningful learning experiences. Therefore, CTL is recommended as an effective instructional approach for improving conceptual understanding in science education at the elementary Islamic school level.

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Introduction

Science learning at the elementary school level plays a fundamental role in shaping students' logical thinking patterns, inquiry skills, and conceptual understanding of natural phenomena. At this stage, students are expected not only to memorize scientific facts but also to develop the ability to interpret, relate, and apply scientific concepts in meaningful contexts. Conceptual understanding is therefore considered a crucial learning outcome in science education because it enables students to construct knowledge structures that support higher-order thinking and problem-solving skills (Anderson & Krathwohl, 2001). Without strong conceptual understanding, science learning tends to become mechanical, fragmented, and limited to surface-level recall.

Conceptual understanding in science refers to students' ability to explain scientific ideas coherently, connect one concept to another, and apply concepts in various real-life situations. This understanding involves cognitive processes such as interpretation, classification, inference, and transfer of knowledge (Bloom, 1956). When students develop conceptual understanding, they are able to recognize relationships among scientific concepts and use them as frameworks to solve contextual problems. Conversely, weak conceptual understanding often leads to misconceptions that hinder learning continuity in advanced topics (Driver, Squires, Rushworth, & Wood-Robinson, 1994).

One of the major challenges in elementary science learning is the persistence of teacher-centered instructional practices that emphasize lecture-based delivery and rote learning. Such practices often reduce students' opportunities to engage in exploration and scientific inquiry. Research indicates that passive learning environments tend to limit meaningful knowledge construction and reduce student engagement in learning processes (Prince, 2004). In many classrooms, students are positioned as recipients of information rather than active constructors of knowledge, which ultimately weakens their conceptual development.

In the context of Indonesian education, science learning in Madrasah Ibtidaiyah faces additional challenges due to the integration of general subjects with Islamic values. Although madrasahs provide a distinctive educational environment, they often encounter constraints such as limited learning resources, traditional teaching approaches, and low instructional innovation (Azra, 2017). This condition may contribute to low learning outcomes, particularly in subjects that require abstract reasoning and scientific explanation.

Furthermore, the rapid development of science and technology in the 21st century demands that students acquire critical thinking skills, scientific literacy, and the ability to apply scientific concepts in daily life. Scientific literacy is not merely the ability to read scientific texts but also the competence to understand scientific processes and make

decisions based on scientific reasoning (Bybee, 2013). Therefore, improving students' conceptual understanding in science learning becomes an essential educational agenda.

The importance of conceptual understanding has been emphasized by constructivist learning theory, which views learning as an active process of knowledge construction. Constructivism suggests that learners build new knowledge by integrating prior experiences with new information through interaction and reflection (Piaget, 1972). From this perspective, science learning should facilitate students in exploring phenomena, asking questions, and connecting new ideas to existing cognitive frameworks.

Similarly, Vygotsky's sociocultural theory highlights that learning is deeply influenced by social interaction and contextual experiences. Students develop understanding through collaboration, dialogue, and guided learning within their zone of proximal development (Vygotsky, 1978). This implies that science learning must be designed to involve meaningful interaction between students, teachers, and learning environments to strengthen conceptual comprehension.

Despite the strong theoretical foundation supporting contextual and interactive learning, empirical evidence shows that many students still struggle to understand science concepts. Misconceptions frequently occur when students interpret scientific ideas using incomplete reasoning or everyday experiences that conflict with scientific explanations (Chi, 2005). Misconceptions are particularly difficult to correct if instructional strategies do not address students' prior knowledge and cognitive structures.

At MIN 5 Lhokseumawe, preliminary observations revealed that students' conceptual understanding in science learning was relatively low. Many students experienced difficulties explaining scientific concepts in their own words and applying them to solve contextual problems. This condition was reflected in students' assessment results, where the majority failed to achieve the minimum mastery criterion. Such findings indicate that learning strategies implemented in the classroom may not have effectively facilitated meaningful learning experiences.

In addition, the observed learning process demonstrated limited student participation. Students tended to rely heavily on teacher explanations and showed minimal engagement in asking questions, discussing ideas, or relating learning material to real-life contexts. This situation aligns with findings from previous studies indicating that low student engagement is strongly associated with weak conceptual understanding and poor academic achievement (Fredricks, Blumenfeld, & Paris, 2004). Therefore, it is necessary to apply an instructional approach that promotes active participation and meaningful engagement.

One instructional approach that has been widely recommended to improve conceptual understanding is the Contextual Teaching and Learning (CTL) model. CTL emphasizes the process of connecting academic content to students' daily experiences, enabling learners to construct knowledge meaningfully. The CTL model is grounded in constructivist principles, which highlight learning as an active process shaped by real-world relevance and problem-solving (Johnson, 2002). By integrating real-life contexts into classroom learning, CTL supports deeper understanding and knowledge retention.

CTL is designed to help students find meaning in learning by relating new information to their existing experiences. According to Berns and Erickson (2001), contextual learning enables students to see the relevance of academic material and encourages them to apply knowledge in practical situations. This approach strengthens cognitive connections and reduces the tendency of students to memorize concepts without comprehension.

Moreover, CTL involves several essential learning components, including inquiry-based learning, questioning strategies, learning communities, modeling, reflection, and authentic assessment. These components encourage students to explore scientific phenomena, engage in collaborative discussion, and reflect on learning outcomes. Such learning experiences are aligned with modern science education goals that prioritize inquiry, reasoning, and scientific problem-solving (National Research Council, 2000).

In science learning, CTL is particularly relevant because science concepts are closely related to real-world phenomena that students encounter daily. Science education should not be separated from students' lived experiences, as this disconnect may lead to abstract and meaningless learning. Research confirms that contextual approaches improve students' understanding by providing concrete examples and experiences that clarify abstract scientific concepts (Glynn & Winter, 2004).

Previous studies have shown that CTL is effective in improving learning outcomes in various educational settings. For example, research by Hudson and Whisler (2008) demonstrated that contextual learning strategies significantly improved students' academic achievement and engagement. Similarly, a study by Sears (2003) found that contextual instruction promotes meaningful learning by enhancing students' motivation and conceptual clarity.

In the Indonesian context, several studies have also reported positive impacts of CTL implementation in elementary classrooms. Nurhadi (2004) emphasized that CTL strengthens learning outcomes because it enables students to learn through real-life problem-solving. Likewise, research by Suryawati and Osman (2018) indicated that contextual learning improved students' scientific literacy and conceptual understanding through interactive and inquiry-based learning activities.

However, despite its proven effectiveness, CTL has not been consistently applied in many madrasah settings. This gap may be influenced by teachers' limited understanding of CTL strategies, lack of professional development opportunities, and reliance on conventional teaching methods. Teachers may also experience difficulties designing contextual learning activities that align with curriculum demands and classroom conditions (Darling-Hammond, Hyler, & Gardner, 2017). Therefore, it is necessary to examine CTL implementation in authentic classroom contexts to provide practical evidence for teachers and policymakers.

Classroom Action Research (CAR) is considered an appropriate methodological approach to address learning problems through systematic intervention and reflection. CAR focuses on improving teaching practices by implementing planned actions, observing results, and reflecting for continuous improvement (Kemmis & McTaggart, 1988). This approach allows teachers to directly evaluate the effectiveness of instructional models and make adjustments based on classroom realities.

CAR is also relevant because it emphasizes practical improvement rather than theoretical generalization. Through iterative cycles, teachers can identify weaknesses in instructional implementation and refine teaching strategies to achieve better learning outcomes. According to Mills (2018), CAR contributes to teacher professionalism by promoting reflective practice and evidence-based instructional decision-making.

In the present study, CTL was implemented through structured learning activities that encouraged students to explore scientific concepts using real-life examples. Students were engaged in collaborative learning, inquiry tasks, and reflective discussion to strengthen conceptual understanding. The learning process was supported by authentic assessment methods that measured not only students' test performance but also their participation and conceptual reasoning.

The novelty of this research lies in its focus on CTL implementation within the context of an Islamic elementary school, where science learning is integrated into a religious educational environment. Madrasahs have unique educational characteristics, and instructional interventions must consider both academic and cultural contexts. Research focusing on contextual learning in madrasahs is still limited, particularly in Aceh, where educational culture and learning practices may differ from other regions (Hidayat, 2019).

Additionally, this study contributes to the growing body of literature on science learning improvement strategies in Indonesian elementary education. It provides empirical evidence that CTL can strengthen conceptual understanding and increase student engagement through contextualized instructional design. This evidence is important because conceptual understanding is often overlooked in favor of procedural knowledge and test-oriented learning outcomes (OECD, 2019).

Therefore, this study aims to investigate how the implementation of the Contextual Teaching and Learning model can improve students' conceptual understanding in science learning at MIN 5 Lhokseumawe. Specifically, this research seeks to examine changes in students' learning outcomes and classroom engagement across action research cycles. The findings are expected to provide practical implications for science teachers, school leaders, and education policymakers in improving science learning quality in madrasah contexts.

Strengthening conceptual understanding in science learning is a crucial challenge that requires innovative and contextually meaningful instructional approaches. CTL offers a promising framework to address this challenge by connecting science concepts to students' daily experiences and encouraging active knowledge construction. Through Classroom Action Research, this study attempts to provide systematic evidence on the effectiveness of CTL in improving conceptual understanding among students in a madrasah environment, particularly at MIN 5 Lhokseumawe.

Methods

This study employed a Classroom Action Research (CAR) design aimed at improving students' conceptual understanding in science learning through the implementation of the Contextual Teaching and Learning (CTL) model at MIN 5 Lhokseumawe. Classroom Action Research was selected because it provides a systematic framework for improving instructional practices through iterative cycles of planning, implementation, observation, and reflection. This approach is particularly relevant for addressing practical classroom problems and evaluating the effectiveness of learning interventions in real teaching contexts (Kemmis & McTaggart, 1988).

The research was conducted at MIN 5 Lhokseumawe, Aceh Province, Indonesia, during the 2024/2025 academic year. The participants consisted of 28 fifth-grade students, comprising 15 male and 13 female students. The selection of participants was based on the researcher's role as a practitioner in the classroom and the identification of learning problems related to low conceptual understanding in science learning. The class was chosen purposively because it represented typical learning challenges observed in the school, particularly in students' limited ability to explain scientific concepts, connect scientific material with daily phenomena, and apply concepts in contextual problem-solving.

The study was conducted in two cycles, and each cycle followed four systematic stages: planning, action, observation, and reflection. This cyclical procedure enabled continuous improvement in instructional implementation and facilitated modifications based on classroom conditions and evaluation results (Mills, 2018).

In the planning stage, the researcher prepared lesson plans based on the CTL model, developed learning materials aligned with the curriculum, designed student worksheets, and arranged contextual learning activities connected to students' real-life experiences. Learning instruments such as observation sheets and conceptual understanding tests were also prepared.

In the action stage, the CTL model was implemented in the classroom. Learning activities were designed to encourage students to actively explore scientific concepts through contextual problems, group discussion, inquiry-based tasks, and reflective activities. The teacher facilitated learning by guiding students to connect scientific content with daily situations, encouraging questioning and reasoning, and providing opportunities for collaborative learning.

In the observation stage, student learning activities and teacher instructional performance were observed using structured observation sheets. Field notes were also taken to document classroom interactions, student responses, and challenges encountered during the learning process. Observation was conducted by a collaborator teacher to ensure objectivity and reduce researcher bias.

In the reflection stage, the results of student learning outcomes and observational data were analyzed to evaluate the effectiveness of CTL implementation. Weaknesses and obstacles identified during Cycle I were used as the basis for revising learning strategies and improving instructional planning for Cycle II. The research was concluded when the predetermined success indicators were achieved.

The CTL model in this study was implemented through key instructional components, including constructivism, inquiry, questioning, learning community, modeling, reflection, and authentic assessment (Johnson, 2002). Students were engaged in exploring scientific phenomena through real-life examples, such as identifying energy sources and observing changes in matter within their daily environment. Inquiry activities were supported through group discussions and problem-solving tasks that required students to analyze phenomena and propose explanations based on scientific reasoning.

Questioning strategies were employed to stimulate students' critical thinking and encourage them to articulate their conceptual understanding. Collaborative learning was implemented through small group activities, allowing students to share ideas, compare explanations, and build collective understanding. Reflection activities were conducted at the end of each learning session to strengthen students' ability to summarize concepts and relate them to daily experiences.

Data collection was conducted using multiple techniques to ensure comprehensive and reliable findings. The primary data were collected through conceptual

understanding tests administered at the pre-cycle stage, the end of Cycle I, and the end of Cycle II. The test consisted of structured questions designed to measure students' ability to explain concepts, classify scientific objects, provide examples, and apply scientific concepts in contextual situations. The test results were used to measure students' conceptual progress across cycles.

In addition to tests, observational data were collected using observation sheets to assess teacher performance and student learning activities during CTL implementation. The student activity observation sheet measured indicators such as participation in discussion, involvement in inquiry tasks, responsiveness to teacher questions, and ability to connect learning material with real-life contexts. Teacher performance observation focused on the ability to facilitate CTL components, classroom management, instructional clarity, and student engagement strategies.

Field notes were also used to record important classroom events, student responses, learning challenges, and reflections during the implementation process. Documentation such as lesson plans, student worksheets, and assessment results were collected as supporting evidence.

The research instruments consisted of conceptual understanding tests, teacher activity observation sheets, student activity observation sheets, and field note guidelines. The conceptual understanding test was developed based on science learning objectives and conceptual indicators aligned with Bloom's cognitive taxonomy (Anderson & Krathwohl, 2001). To ensure content validity, the test items were reviewed by science education experts and experienced teachers. The observation sheets were designed using a Likert-scale format to quantify the level of teacher performance and student engagement during learning activities.

The data analysis in this study was conducted using both quantitative and qualitative approaches. Quantitative data were derived from students' test scores and observation sheet results. Students' learning achievement was analyzed by calculating the class average score and the percentage of students who achieved the minimum mastery criterion (MMC), which was set at 75. The percentage of mastery learning was calculated using the following formula:

Mastery Percentage = (Number of students achieving MMC / Total number of students) × 100%

Class average scores were calculated to measure overall improvement across cycles. Observation data were analyzed by calculating the percentage of achievement for teacher and student activity indicators. The results were then interpreted based on predetermined criteria to evaluate improvement.

Qualitative data from field notes were analyzed through descriptive interpretation. The data were categorized into themes such as student engagement, learning difficulties, classroom interaction patterns, and the effectiveness of CTL components. Qualitative findings were used to support and explain quantitative results, providing deeper insights into learning process changes during the intervention.

The success of the study was determined based on predetermined criteria. First, the implementation of CTL was considered successful if at least 85% of students achieved the minimum mastery criterion (MMC = 75) in conceptual understanding tests. Second, student learning activity was expected to reach at least 80% in observation results, indicating active participation in CTL-based learning. Third, teacher performance in implementing CTL components was expected to reach at least 85%, reflecting effective facilitation of contextual learning. These indicators were used as benchmarks to decide whether the research should proceed to the next cycle or be concluded.

This study adhered to ethical principles in educational research. Permission to conduct the research was obtained from the school principal and relevant authorities. Students and their parents were informed about the purpose and procedures of the study. Participation in learning activities was conducted as part of regular classroom instruction without disrupting students' learning rights. All collected data were treated confidentially, and students' identities were anonymized to protect privacy and ensure ethical compliance.

Result

This section presents the empirical findings obtained from the Classroom Action Research (CAR) conducted at MIN 5 Lhokseumawe through the implementation of the Contextual Teaching and Learning (CTL) model. The research findings are described based on quantitative data from conceptual understanding tests and observation results of teacher performance and student learning activities. The data were collected across three stages: pre-cycle, Cycle I, and Cycle II. The minimum mastery criterion (MMC) for science learning at MIN 5 Lhokseumawe was determined as 75.

Students' Conceptual Understanding Test Results

Students' conceptual understanding was measured using achievement tests administered in the pre-cycle stage, at the end of Cycle I, and at the end of Cycle II. The tests assessed students' ability to explain scientific concepts, classify objects based on scientific characteristics, provide examples of concepts, and apply concepts in real-life contexts. The overall results show a consistent improvement across cycles, indicating that CTL significantly supported students' conceptual development in science learning. Table 1 presents a summary of students' test results across the research stages.

Table 1. Students' Conceptual Understanding Achievement Across Cycles

Research Stage	Average Score	Students Achieving MMC (≥75)	Percentage (%)	Students Not Achieving MMC	Percentage (%)
Pre-Cycle	68.1	10	35.71	18	64.29
Cycle I	75.6	18	64.29	10	35.71
Cycle II	84.2	25	89.29	3	10.71

The data in Table 1 demonstrate that students' conceptual understanding improved substantially after CTL implementation. In the pre-cycle stage, the average score was 68.21, and only 10 students (35.71%) met the mastery criterion. Most students (64.29%) failed to achieve mastery, reflecting low conceptual comprehension and limited ability to apply scientific concepts.

After CTL was applied in Cycle I, the average score increased to 75.46. The number of students who achieved mastery also rose significantly to 18 students (64.29%). This improvement indicates that CTL was able to enhance students' conceptual understanding, although the success indicator had not yet been achieved because the target mastery level was at least 85%.

Further improvement occurred in Cycle II. The average score increased to 84.32, and 25 students (89.29%) achieved mastery. Only 3 students (10.71%) remained below the minimum criterion. These results confirm that CTL implementation successfully improved conceptual understanding, and the predetermined success indicator was achieved in Cycle II.

Improvement in Student Learning Activities

Student learning activities were observed during Cycle I and Cycle II using structured observation sheets. The observed indicators included participation in group discussions, responsiveness to teacher questions, involvement in inquiry activities, collaboration with peers, and ability to connect science material with real-life contexts. The observation results indicate a significant increase in student engagement during CTL implementation. Table 2 summarizes student activity observation results.

Table 2. Student Learning Activity Observation Results

Cycle	Average Student Activity Score (%)	Category
Cycle I	70.15	Moderate
Cycle II	87.60	High

Based on Table 2, student activity in Cycle I reached 70.15%, categorized as moderate. Although CTL had begun to encourage student involvement, some students were still hesitant to actively express ideas, ask questions, or engage in inquiry-based tasks. In Cycle II, student activity increased to 87.60%, categorized as high. This indicates that students became more confident, collaborative, and engaged in learning processes when CTL was implemented more effectively.

Qualitative observations also revealed that students in Cycle II were more motivated to relate science concepts to daily life experiences. Students were able to provide examples from their environment and discuss scientific phenomena more actively. The learning community component of CTL encouraged peer support and reduced students' fear of making mistakes.

Teacher Performance Observation Results

Teacher performance was observed to assess the quality of CTL implementation. The observation indicators included the teacher's ability to present contextual problems, facilitate inquiry learning, encourage questioning, manage group discussions, provide modeling, guide reflection, and apply authentic assessment. Table 3 presents teacher performance results across cycles.

Table 3. Teacher Performance Observation Results

Cycle	Average Teacher Performance Score (%)	Category
Cycle I	76.40	Good
Cycle II	90.25	Very Good

The data indicate that teacher performance improved significantly across cycles. In Cycle I, the teacher performance score was 76.40%, categorized as good. The teacher was able to implement CTL components, but some aspects were not optimal, such as managing time for reflection activities and ensuring equal participation among students during group discussions.

In Cycle II, teacher performance increased to 90.25%, categorized as very good. The teacher demonstrated stronger facilitation skills, provided clearer contextual examples, guided inquiry tasks more effectively, and encouraged students to express ideas through questioning and discussion. This improvement contributed directly to better student engagement and conceptual understanding outcomes.

Summary of Overall Improvement

To provide a clearer picture of progress across the research stages, Table 4 presents a comprehensive summary of improvements in learning outcomes, student activity, and teacher performance.

Table 4. Summary of Improvements Across Research Stages

Indicator	Pre-Cycle	Cycle I	Cycle II
Average Conceptual Understanding Score	68.21	75.46	84.3
Mastery Learning Percentage (%)	35.71	64.29	89.2
Student Learning Activity (%)	-	70.15	87.6
Teacher Performance (%)	-	76.40	90.2

The overall results show that CTL implementation had a strong positive impact on the learning process and learning outcomes. Conceptual understanding scores and mastery levels increased significantly from pre-cycle to Cycle II. Student learning activity improved from moderate to high, and teacher performance increased from good to very good. These findings indicate that CTL effectively supported meaningful science learning experiences and strengthened students' conceptual understanding.

Discussion

The findings of this study confirm that the Contextual Teaching and Learning (CTL) model is effective in improving students' conceptual understanding in science learning at MIN 5 Lhokseumawe. The improvement was evident not only in test scores but also in student engagement and teacher instructional performance. These results align with constructivist learning theory, which emphasizes that meaningful learning occurs when students actively construct knowledge through interaction with real-life experiences and social learning environments (Piaget, 1972; Vygotsky, 1978).

The significant increase in conceptual understanding scores from 68.21 in the pre-cycle to 84.32 in Cycle II demonstrates that CTL facilitated deeper learning compared to conventional instructional approaches. This improvement indicates that students were increasingly able to understand scientific concepts, explain them using their own reasoning, and apply them to contextual problems. According to Anderson and Krathwohl (2001), conceptual understanding is reflected in students' ability to interpret, classify, exemplify, and apply knowledge. The results of this study suggest that CTL strengthened these cognitive processes by creating learning experiences that required students to connect abstract science concepts with observable phenomena in their daily environment.

The improvement in mastery learning percentage from 35.71% in the pre-cycle to 89.29% in Cycle II also provides strong evidence of CTL effectiveness. This improvement can be explained by the contextual nature of CTL, which emphasizes relevance and meaningfulness in learning. Johnson (2002) argued that CTL helps students understand academic material because it is linked to real-life situations, making learning more meaningful and easier to internalize. In this study, students were encouraged to observe scientific phenomena around them, discuss their observations with peers, and relate them to scientific explanations. This process enabled students to build cognitive connections that enhanced conceptual clarity.

The results also indicate that student learning activity increased from 70.15% in Cycle I to 87.60% in Cycle II. This improvement suggests that CTL successfully promoted active learning and reduced passive classroom behavior. Active participation is essential in science learning because scientific understanding develops through inquiry, experimentation, discussion, and reflection (National Research Council, 2000). The inquiry component of CTL encouraged students to explore scientific concepts through observation and questioning, which strengthened their engagement and motivation. Prince (2004) emphasized that active learning strategies significantly improve students' comprehension and retention of learning material, which supports the findings of this research.

Furthermore, the learning community component of CTL played a critical role in increasing student engagement. Students were required to collaborate in groups, share ideas, and provide explanations during discussions. This collaborative environment supported the development of conceptual understanding because students were exposed to diverse perspectives and reasoning patterns. Vygotsky (1978) explained that cognitive development is enhanced through social interaction and collaborative learning, particularly when students engage in meaningful dialogue. The increase in student activity observed in Cycle II indicates that students became more confident and comfortable participating in discussions, which contributed to improved conceptual understanding.

The improvement in teacher performance from 76.40% in Cycle I to 90.25% in Cycle II also influenced the success of CTL implementation. Teacher performance is a crucial factor in contextual learning because the teacher must be able to facilitate inquiry, provide relevant examples, guide reflection, and manage group learning effectively. Darling-Hammond et al. (2017) highlighted that teacher instructional quality strongly determines learning effectiveness, particularly in innovative learning models that require active facilitation. In this study, teacher performance improved after reflection and revision in Cycle II, enabling CTL components to be implemented more consistently and effectively.

One important factor contributing to improved learning outcomes was the use of questioning strategies in CTL. Questioning is essential for stimulating critical thinking and encouraging students to articulate their conceptual understanding. Chi (2005) emphasized that conceptual change occurs when students actively process information and confront their misconceptions through questioning and explanation. In this study, the teacher encouraged students to ask questions related to daily phenomena and guided them to identify scientific explanations. This process supported students in correcting misconceptions and building stronger conceptual frameworks.

The reflection component of CTL also contributed to improved conceptual understanding. Reflection activities allowed students to summarize what they had learned and connect new knowledge to their prior experiences. Reflection strengthens cognitive organization and supports long-term retention of conceptual knowledge (Boud, Keogh, & Walker, 1985). In Cycle II, reflection activities were implemented more systematically, which likely contributed to the higher average test scores and increased mastery learning percentage.

Another significant aspect of CTL is authentic assessment, which evaluates students' understanding through real-life application rather than memorization. Authentic assessment encourages students to demonstrate learning outcomes through practical problem-solving and contextual reasoning (Wiggins, 1990). In this study, students were assessed not only through written tests but also through observation of participation and inquiry tasks. This approach allowed students to demonstrate conceptual understanding more comprehensively, which supported improvement in learning outcomes.

The findings of this research are consistent with previous studies showing that CTL improves science learning outcomes. Hudson and Whisler (2008) found that contextual instruction enhances student motivation and academic achievement by connecting learning material to real-life experiences. Similarly, Suryawati and Osman (2018) reported that contextual learning strategies improved students' scientific literacy and conceptual understanding in Indonesian elementary schools. The consistency between

this study and previous research strengthens the argument that CTL is an effective instructional approach for improving science learning outcomes.

Moreover, the success of CTL implementation in this madrasah context demonstrates that contextual learning can be effectively integrated into Islamic educational environments. Although madrasahs have unique learning cultures, CTL provides flexibility to incorporate religious values and local contexts into learning activities. This aligns with Azra (2017), who emphasized the importance of modernizing madrasah instruction through innovative teaching models while maintaining Islamic educational identity.

The improvement in students' conceptual understanding also indicates that CTL may reduce the dominance of rote learning practices, which are still common in many elementary classrooms. Rote learning often results in superficial understanding and limits students' ability to apply knowledge (Bransford, Brown, & Cocking, 2000). The significant improvement in test scores and mastery learning suggests that CTL successfully shifted learning processes toward meaningful learning experiences, enabling students to construct knowledge actively.

Despite the positive findings, some challenges were observed during Cycle I. Students initially experienced difficulty adapting to inquiry-based learning activities, particularly in expressing ideas and participating in discussions. This challenge is common when students are accustomed to teacher-centered instruction. However, through consistent facilitation, modeling, and collaborative learning, students gradually became more engaged in Cycle II. This finding supports the argument that contextual learning requires gradual adaptation and strong teacher guidance to ensure successful implementation (Johnson, 2002).

Overall, the findings confirm that CTL is effective in improving students' conceptual understanding in science learning. The improvement occurred because CTL facilitated meaningful learning experiences through inquiry, collaboration, questioning, reflection, and authentic assessment. These components encouraged students to actively engage in learning processes, connect scientific concepts to daily life, and develop deeper conceptual understanding. Therefore, CTL can be considered a recommended instructional model for science learning improvement in madrasah and elementary school contexts.

In addition, the results highlight the importance of reflective teaching practices through Classroom Action Research. CAR enabled the teacher to identify weaknesses in Cycle I and improve instructional strategies in Cycle II. This process aligns with Kemmis and McTaggart (1988), who emphasized that CAR supports continuous instructional improvement through systematic reflection. The success of this study suggests that CAR

can serve as an effective framework for teachers to implement innovative learning models and enhance educational quality.

In conclusion, the implementation of CTL in science learning at MIN 5 Lhokseumawe significantly improved students' conceptual understanding, increased student engagement, and strengthened teacher instructional performance. These findings provide empirical evidence that contextual learning is an effective strategy for improving science education quality in elementary Islamic schools.

Conclusion

This classroom action research concludes that the implementation of the Contextual Teaching and Learning (CTL) model effectively improved students' conceptual understanding in science learning at MIN 5 Lhokseumawe. The findings demonstrated a consistent increase in learning achievement, where the average conceptual understanding score improved from 68.21 in the pre-cycle stage to 75.46 in Cycle I and reached 84.32 in Cycle II, accompanied by an increase in mastery learning from 35.71% to 89.29%. In addition, student learning activities showed significant improvement from 70.15% in Cycle I to 87.60% in Cycle II, indicating higher engagement and active participation in inquiry-based and collaborative learning processes. Teacher performance also improved from 76.40% to 90.25%, reflecting better instructional facilitation and more effective integration of CTL components such as inquiry, questioning, reflection, and authentic assessment. Overall, these results confirm that CTL fosters meaningful learning by linking scientific concepts to real-life contexts, strengthening students' cognitive construction of knowledge, and enhancing classroom interaction. Therefore, CTL is strongly recommended as an effective instructional approach for improving conceptual understanding and learning quality in elementary science education, particularly within the madrasah context.

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