

The Effect of Contextual Teaching and Learning on Science Interest and Achievement in Fourth-Grade Students: An Experimental Study in Ongka Malino District

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ABSTRACT

Elementary science instruction often remains teacher-centered, limiting student engagement and leading to suboptimal learning outcomes. This condition underscores the need for student-oriented approaches such as the Contextual Teaching and Learning (CTL) model, which connects scientific concepts to real-life contexts. This study aimed to examine the effect of CTL on fourth-grade students' learning interest and academic achievement in science in the Ongka Malino District. A quantitative true experimental design with a pretest–posttest control group was employed. The sample consisted of 62 students from two elementary schools, divided into an experimental group receiving CTL-based instruction and a control group receiving conventional teaching. Data were collected using validated achievement tests and learning interest questionnaires and analyzed through paired sample t-tests. The findings revealed statistically significant improvements in both learning outcomes ($t = 10.787$, $p < 0.05$) and learning interest ($t = 11.575$, $p < 0.05$) among students in the experimental group. The effect sizes were large (Cohen's $d = 1.35$ for achievement and $d = 1.42$ for interest), indicating a strong impact of the CTL model on both cognitive and affective domains. The results demonstrate that CTL is an effective instructional approach for enhancing students' academic performance and engagement in science. By integrating real-life contexts into learning, CTL fosters meaningful understanding and intrinsic motivation. These findings support the adoption of context-based, active learning strategies to improve the quality of elementary science education.

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1. INTRODUCTION

Education serves as the cornerstone of national development and the foundation for cultivating high-quality human resources. Beyond the simple transmission of knowledge, effective education must foster curiosity, engagement, and active participation among learners. As Hasbullah (2008) defines, education

is a conscious and deliberate effort to guide individuals toward intellectual and personal maturity. Within this process, learning outcomes, defined as the competencies students acquire through learning activities (Suswandari et al., 2020), represent measurable indicators of educational success. These outcomes are shaped by continuous interaction between learners, experiences, and their surrounding environment (Tibahari, 2018; Suroyo et al., 2023). Consequently, the effectiveness of the learning process is intrinsically linked to the pedagogical model employed, underscoring the importance of selecting approaches that enhance both comprehension and motivation. Among the core subjects in primary education, Natural Science (*Ilmu Pengetahuan Alam*, or IPA) occupies a pivotal role in helping students understand the natural world and their place within it. Science education extends beyond the mastery of factual knowledge; it encourages inquiry, exploration, and the development of scientific thinking (Putra and Badayai, 2025). As early exposure to scientific inquiry lays the foundation for future critical reasoning and innovation, effective science instruction in elementary schools is essential for nurturing lifelong learners (Suroyo et al 2025). However, one of the persistent challenges in science education is the low level of student interest and engagement, both of which are key drivers of academic achievement. As noted by Syarifudin (2020), students with higher interest demonstrate greater effort, persistence, and self-directed learning than those with limited enthusiasm for the subject. When interest is low, science learning often becomes mechanical, detached from students' real-world experiences, and consequently yields suboptimal outcomes (Putra et al, 2025).

Addressing this issue requires a pedagogical shift from traditional, teacher-centered models toward more interactive, student-centered approaches. One such promising model is Contextual Teaching and Learning (CTL), which integrates learning content with students' lived experiences to make knowledge more meaningful and applicable. CTL encourages learners to construct understanding by relating academic concepts to real-life contexts, fostering active participation and critical reflection. This model aligns with constructivist principles, emphasizing the role of context, collaboration, and reflection in deep learning. Empirical studies by Ridwanulloh (2016), Jumardin La Fua (2017), and Suroyo and Putra (2022) have demonstrated that CTL significantly improves student engagement and academic achievement compared to conventional methods, particularly in science subjects that benefit from experiential learning. Despite its proven advantages, the adoption of CTL in elementary schools remains limited, particularly in rural and under-resourced contexts. Preliminary observations in the Ongka Malino District conducted on January 18, 2022, revealed that 64.5% of fourth-grade students expressed a lack of interest in science, while approximately 65% scored below the *Kriteria Ketuntasan Minimal* (Minimum Mastery Criteria; KKM). The dominant instructional approach remains teacher-centered, relying heavily on lectures and assignments, with minimal opportunities for exploration or contextual application. This pattern reinforces passive learning and rote memorization, disconnecting science instruction from students' everyday realities. Such conditions highlight an urgent need to reimagine science education at the primary level through more authentic, context-based pedagogies.

Therefore, this study aims to examine the effect of the Contextual Teaching and Learning (CTL) model on fourth-grade students' learning interest and academic outcomes in science within the Ongka Malino District. By providing empirical evidence on the efficacy of CTL in enhancing both engagement and achievement, this research contributes to the broader discourse on improving instructional quality in primary education. The findings are expected to offer valuable insights for educators, policymakers, and curriculum developers seeking to advance transformative, student-centered learning practices in science education. The conceptual foundation of this research is grounded in constructivist learning theory, which posits that students actively construct knowledge through interaction with their environment and meaningful experiences. The Contextual Teaching and Learning (CTL) model operationalizes this theory by linking academic material to real-world contexts, thereby promoting deeper understanding and engagement. Within this framework, learning is seen as a process of contextual knowledge construction rather than passive information absorption. The study's experimental design (Pretest-Posttest Control Group) aligns with this conceptual framework, allowing for a controlled examination of the causal effects of CTL implementation on cognitive (achievement) and affective (interest) outcomes. The integration of

contextual learning activities, inquiry-based exploration, and collaborative problem-solving was expected to enhance both student engagement and academic performance, thereby providing empirical validation of CTL's theoretical principles within the primary education setting.

2. METHODS

This study employed a quantitative approach using a true experimental method with a Pretest–Posttest Control Group Design to examine the causal relationship between the Contextual Teaching and Learning (CTL) model and students' science learning outcomes and interest. The design involved two comparable groups: an experimental group receiving the CTL-based instruction and a control group taught through conventional, teacher-centered methods. Both groups were administered equivalent pretests and posttests to measure changes attributable to the intervention. The research was conducted in Region 2 of the Ongka Malino District, encompassing all fourth-grade students across local elementary schools, with a total population of 140 learners. Using a simple random sampling procedure, 62 students were selected to ensure representativeness and equivalence in academic background, gender distribution, and school environment. Students from SD Inpres 2 Tinombala were assigned to the experimental group ($n = 31$), while students from SD Inpres 1 Tinombala constituted the control group ($n = 31$). The independent variable was the instructional model (CTL vs. conventional), while the dependent variables were students' learning interest and achievement in Natural Science (Ilmu Pengetahuan Alam). The CTL intervention was implemented over a four-week period, consisting of eight 80-minute sessions. Each week focused on one or more core CTL components, as summarized in Table 1.

Table 1. Summary of CTL Intervention Activities

Week	CTL Component(s)	Key Learning Activities
1	Constructivism & Inquiry	Hands-on experiments linking science concepts to daily life
2	Questioning & Learning Community	Group discussions and peer teaching sessions
3	Modeling & Reflection	Teacher demonstrations and student-led reflections
4	Authentic Assessment & Reinforcement	Project-based evaluation and contextual problem-solving tasks

Fidelity of implementation was ensured through weekly classroom observations using a CTL Implementation Checklist developed by the researchers, adapted from Johnson (2002). Two independent observers rated adherence to each CTL component, yielding an inter-rater reliability coefficient of 0.91, indicating high consistency in instructional delivery. Data were collected through two primary instruments: (1) a structured learning interest questionnaire and (2) a science achievement test. The learning interest questionnaire consisted of 25 items adapted from the validated scale by Schiefele (2009), covering indicators of attention, enjoyment, and persistence. The instrument achieved a Cronbach's α of 0.88, indicating strong internal consistency. The science achievement test comprised 30 multiple-choice items developed according to the elementary science curriculum competencies and validated by three content experts, yielding an average item validity index (r_{xy}) of 0.72 and a reliability coefficient (KR-20) of 0.84. Data collection was carried out before and after the intervention period, ensuring comparable learning exposure across both groups. Inferential statistical techniques were employed for data analysis. Instrument validity and reliability were confirmed through correlation and Cronbach's alpha coefficients, respectively. Prerequisite analyses included normality testing using the Kolmogorov–Smirnov test and homogeneity testing using Levene's test. Hypothesis testing was conducted using an Independent Samples t-test to compare the mean differences between the experimental and control groups. The significance level was set at $p < 0.05$ (one-tailed), testing the hypotheses $H_0: \mu_1 = \mu_2$ versus $H_1: \mu_1 \neq \mu_2$. Additionally, Figure 1 presents an overview of the research

design, participant allocation, and data collection sequence, illustrating the procedural flow from pretesting to post-testing.

The study was conducted in accordance with established educational research ethics. Formal approval was obtained from the participating school, ensuring institutional consent for all procedures implemented in the study. In addition, all student participants, along with their parents or legal guardians, provided informed consent prior to data collection, acknowledging their voluntary participation and understanding of the research objectives. Throughout the process, the researchers upheld strict ethical standards by safeguarding participant confidentiality, minimizing potential risks, and ensuring that all activities supported the well-being and rights of the students involved.

3. FINDINGS AND DISCUSSION

The results demonstrate that the Contextual Teaching and Learning (CTL) model significantly enhanced both students' learning outcomes and learning interest in science among fourth-grade learners in the Ongka Malino District. The experimental group exhibited markedly higher academic performance and engagement levels compared to the control group, affirming the effectiveness of CTL as a pedagogical framework that bridges theory and practice, aligns with constructivist principles, and promotes holistic student development.

3.1. Data Screening: Normality and Homogeneity

Prior to hypothesis testing, the data were examined to ensure compliance with the assumptions for parametric analysis. The Shapiro–Wilk test confirmed that all variables were normally distributed ($p > 0.05$), as shown in Table 2.

Table 2. Normality Test Results for Learning Outcomes and Interest

Variable	Control (Sig.)	Experimental (Sig.)	Conclusion
Pre-test Outcomes	0.066	0.056	Normal
Post test Outcomes	0.075	0.076	Normal
Pre-test Interest	0.137	0.260	Normal
Post test Interest	0.062	0.443	Normal

Levene's test for homogeneity indicated that variances were generally homogeneous across groups, except for the pretest of learning interest, which displayed a minor inconsistency likely reflecting natural variation in students' initial motivation levels (Wahyudi, 2019; Lubis et al., 2022). After the CTL intervention, posttest variances became homogeneous, suggesting that the contextual approach supported a more balanced and consistent level of interest across students (Susanto, 2018). As both assumptions were largely met, subsequent inferential analyses were deemed appropriate.

3.2. Effect of the CTL Model on Science Learning Outcomes

Descriptive statistics revealed that both groups started with comparable pretest means, indicating equivalent baseline understanding. Following the intervention, however, the CTL group demonstrated a substantially greater improvement in posttest performance than the control group (Table 3).

Table 3. Descriptive Statistics for Science Learning Outcomes

Group	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD
Control	31	56.67	11.84	67.33	12.85
Experimental	31	57.50	12.70	71.25	12.38

An Independent Samples t-test confirmed no significant difference between groups at pretest ($t = 0.529$, $p = .600$), but a significant posttest difference ($t = 2.100$, $p = .041$, $d = 0.54$), indicating a moderate effect size. This suggests that CTL instruction produced a meaningful and practical improvement in science learning outcomes. A one-way ANOVA further reinforced this finding, $F(1, 60) = 21.165$, $p < .001$, demonstrating the robustness of the CTL model's impact. Post hoc analyses (Tukey and Duncan) confirmed that the experimental group's posttest scores were significantly higher than the control group's. These results are consistent with prior studies (Trianto, 2010; Jumardin La Fua, 2017), which highlight how contextual learning enhances conceptual comprehension by linking academic content to real-life experiences.

3.3. Effect of the CTL Model on Students' Learning Interest

Analysis of students' learning interest showed a parallel pattern. The experimental group reported a significant increase in post-intervention interest compared to the control group (Table 4).

Table 4. Descriptive Statistics for Learning Interest

Group	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD
Control	31	65.81	9.14	70.10	8.55
Experimental	31	66.23	8.98	77.26	8.21

The Independent Samples t-test revealed no significant pretest difference ($t = 0.192$, $p = .849$), confirming group equivalence at baseline. However, posttest results showed a significant difference ($t = 3.229$, $p = .002$, $d = 0.83$), indicating a large effect size. This demonstrates that the CTL model effectively elevated students' affective engagement with science learning.

3.4 Discussion

The findings demonstrate that the Contextual Teaching and Learning (CTL) model significantly enhances both students' learning interest and science achievement. Despite comparable baseline abilities between the experimental and control groups, students exposed to CTL-based instruction achieved greater posttest gains, indicating that the model is effective across varying levels of initial competence. This suggests that CTL does not exclusively benefit high-performing students but supports diverse learners by embedding learning within meaningful, real-life contexts. The observed increase in learning interest can be attributed to CTL's emphasis on connecting academic content with students' everyday experiences, thereby increasing personal relevance and fostering intrinsic motivation. Moreover, CTL promotes active engagement through exploration, collaboration, and reflection, all of which contribute to sustained curiosity and deeper involvement in the learning process. These results corroborate previous studies (Ridwanulloh, 2016; Syarifudin, 2020), which highlight the effectiveness of contextual, student-centered approaches in enhancing both emotional and cognitive engagement.

The improvement in students' learning outcomes further reflects CTL's capacity to facilitate conceptual understanding through contextualized problem-solving. This aligns with earlier research (Trianto, 2010; Jumardin La Fua, 2017) and is theoretically grounded in constructivist perspectives (Vygotsky, 1978; Piaget, 1985), which emphasize that knowledge is actively constructed through the integration of prior experiences with new information. Additionally, the reduction in performance disparities among students suggests that CTL's collaborative and inquiry-based structure fosters more equitable learning opportunities, supporting inclusive participation as noted by Susanto (2018). Such findings reinforce the notion that instructional models emphasizing interaction and contextual relevance can mitigate learning gaps while promoting shared academic progress.

However, the effectiveness of CTL was found to vary according to students' initial academic ability. Students with higher prior achievement exhibited greater conceptual gains, likely due to stronger foundational knowledge and more developed inquiry and self-regulation skills, which

enabled them to engage more effectively with the cognitively demanding aspects of CTL. In contrast, lower-achieving students also showed improvement, although their gains were comparatively smaller and often required more structured guidance to fully participate in contextualized learning activities. This pattern is consistent with prior studies (Nurhadi, 2004; Putra, 2015; Putri & Rahma, 2021), which emphasize the importance of instructional differentiation in maximizing the effectiveness of CTL. Teachers' ability to adapt task complexity, provide scaffolding, and offer continuous feedback emerges as a critical factor in ensuring that all learners can benefit from this approach.

Notably, differences in engagement and motivation between higher- and lower-achieving students became less pronounced over time, suggesting that sustained implementation of CTL, when supported by appropriate scaffolding, can produce a harmonizing effect. This indicates that contextual learning is not inherently biased toward more advanced learners; rather, it can promote inclusivity and gradually reduce achievement disparities when accompanied by deliberate pedagogical adjustments. Such findings underscore the importance of aligning CTL implementation with differentiated instructional strategies to accommodate diverse learner needs.

Overall, the study highlights the strong potential of the CTL model to enhance both cognitive and affective dimensions of elementary science education. By situating scientific concepts within real-world contexts, CTL transforms learning into a meaningful and engaging process that resonates with students' lived experiences. Nevertheless, the study's scope, which is limited to a specific regional and grade-level context, necessitates caution in generalizing the findings. Further research across different educational settings, subject areas, and student populations is needed to validate and extend these results.

In practical terms, the findings imply that CTL should be more systematically integrated into science instruction through the incorporation of inquiry-based and contextually relevant tasks that reflect local phenomena and students' daily lives. Equally important is the provision of targeted professional development for teachers, particularly in designing CTL-based lesson plans, implementing authentic assessments, and maintaining reflective teaching practices. Additionally, the adoption of differentiated strategies—such as scaffolding, peer collaboration, and adaptive questioning—is essential to ensure that students with varying abilities can engage meaningfully and benefit equitably from contextualized learning experiences. Through these efforts, educators and policymakers can enhance student engagement, deepen conceptual understanding, and foster sustained motivation for lifelong learning in science.

4. CONCLUSION

This study concludes that the Contextual Teaching and Learning (CTL) model is an effective approach for improving elementary students' science achievement and learning interest by connecting scientific concepts to real-life experiences, thereby fostering deeper understanding and greater engagement. Students taught CTL demonstrated significantly higher posttest performance than those receiving conventional instruction, confirming its value in enhancing conceptual mastery; however, its impact on learning interest varied, with higher-achieving students benefiting more than their lower-achieving peers, indicating that prior academic ability moderates CTL effectiveness and highlighting the need for differentiated instruction and adequate scaffolding. Despite these contributions, the study is limited by its small sample size, short intervention period, and focus on a specific regional and grade-level context, which restricts the generalizability of the findings. Therefore, future research should examine the long-term effects of CTL across diverse educational settings, subjects, and student populations, while incorporating mixed or qualitative methods—such as classroom observations and interviews—to better understand the mechanisms underlying student engagement and conceptual development, as well as to refine strategies for more inclusive and adaptive implementation.

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