Journal of Research in Instructional
e-ISSN: 2776-222X
Vol. 6(1) 2026, pp. 370 – 383
https://doi.org/10.30862/jri.v6i1.59

Science learning with a contextual approach based on local wisdom for to enhance elementary school students achievement

Rahman Rahman*, Shirly Rizki Kusumaningrum, Mardhatillah Mardhatillah

Universitas Negeri Malang, Indonesia

Submitted:
25-09-2025

Accepted:
10-01-2026

Published:
30-06-2026

Abstract: Elementary science learning requires instructional approaches that enable students to connect scientific concepts with authentic experiences that are meaningful within their own cultural and environmental contexts. However, science instruction in many elementary classrooms remains predominantly teacher-centered, limiting students' conceptual understanding and meaningful engagement with science. This study aimed to compare the effectiveness of contextual teaching and learning (CTL) integrated with local wisdom and direct instruction in improving elementary students' science learning achievement. A quasi-experimental study employing a posttest-only control group design was conducted with 60 fifth-grade students from SDN 020 Tana Tidung, Indonesia. The experimental group received CTL integrated with local wisdom, whereas the control group was taught using direct instruction. Students' science learning achievement was measured using a 25-item multiple-choice test that demonstrated satisfactory content validity (Aiken's V = 0.83) and internal consistency reliability (Cronbach's α = 0.87). Data were analyzed using an independent samples *t*-test following normality and homogeneity assumption testing. The results showed that the experimental group achieved a higher mean posttest score (82.00) than the control group (74.50), and the difference was statistically significant ($p < .05$). These findings indicate that integrating local wisdom into CTL provides a more meaningful learning environment by connecting scientific concepts with students' everyday cultural and environmental experiences. This study contributes to the growing evidence supporting culturally responsive science education and suggests that integrating local wisdom into contextual learning can enhance elementary students' science achievement.

Keywords: Contextual teaching and learning, learning achievement, elementary science

Abstrak: Pembelajaran IPA di sekolah dasar memerlukan pendekatan yang memungkinkan siswa menghubungkan konsep-konsep sains dengan pengalaman autentik yang bermakna dalam konteks budaya dan lingkungan mereka. Namun, pembelajaran IPA di banyak kelas sekolah dasar masih didominasi pendekatan berpusat pada guru, sehingga membatasi pemahaman konseptual dan keterlibatan bermakna siswa. Penelitian ini bertujuan membandingkan efektivitas *contextual teaching and learning* (CTL) terintegrasi kearifan lokal dan *direct instruction* dalam meningkatkan hasil belajar IPA siswa sekolah dasar. Penelitian ini menggunakan desain kuasi-eksperimen posttest-only control group design dengan melibatkan 60 siswa kelas V SDN 020 Tana Tidung, Indonesia. Kelas eksperimen memperoleh pembelajaran CTL terintegrasi kearifan lokal, sedangkan kelas kontrol diajar menggunakan *direct instruction*. Hasil belajar IPA diukur menggunakan tes pilihan ganda 25 butir yang memiliki validitas isi memadai (Aiken's V = 0,83) dan reliabilitas internal yang baik (Cronbach's α = 0,87). Data dianalisis menggunakan independent samples *t*-test setelah pengujian asumsi normalitas dan homogenitas. Hasil penelitian menunjukkan bahwa kelas eksperimen memperoleh rerata posttest lebih tinggi (82,00) dibandingkan kelas kontrol (74,50), dan perbedaan tersebut signifikan secara statistik ($p < 0,05$). Temuan ini menunjukkan bahwa integrasi kearifan lokal dalam CTL menyediakan lingkungan belajar yang lebih bermakna dengan menghubungkan konsep sains dengan pengalaman budaya dan lingkungan sehari-hari siswa. Penelitian ini mendukung pengembangan pendidikan IPA yang responsif budaya dan menegaskan bahwa integrasi kearifan lokal dalam pembelajaran kontekstual dapat meningkatkan hasil belajar IPA siswa sekolah dasar.

Kata kunci: Contextual teaching and learning, hasil belajar, IPA sekolah dasar

*Corresponding author: rahman.2421038@students.um.ac.id

INTRODUCTION

Science learning in elementary schools still faces persistent challenges related to students' limited conceptual understanding and insufficient development of science process skills, which are often attributed to teacher-centered instructional practices. Recent studies highlight that learning approaches that promote active engagement and meaningful context can enhance scientific thinking and students' cognitive outcomes. For instance, Melesse (2025) found that the implementation of a context-based instructional approach significantly improved integrated science process skills (ISPS) among elementary students. Building on this evidence, contextual learning frameworks continue to gain attention due to their capacity to bridge formal scientific concepts with real-life experiences, thereby improving students' cognitive engagement and knowledge retention (Kadir et al., 2023; Khalaf & Zin, 2022; Nasir et al., 2024). Such findings reinforce the relevance of examining pedagogical approaches that support deeper conceptual understanding at the elementary level.

While multiple instructional approaches are discussed in science education literature, contextual teaching and learning (CTL) is conceptually distinct and should not be equated with inquiry-based learning. CTL emphasizes the integration of learning materials with students' authentic experiences and sociocultural contexts, whereas inquiry-based learning focuses on student-led investigation and problem-solving processes. Therefore, CTL stands as a unique pedagogical model grounded in sociocultural and constructivist principles, rather than as a subset or variation of inquiry-based instruction (Berns & Erickson, 2018; Johnson, 2014). Clarifying this distinction is crucial because misinterpreting CTL as synonymous with inquiry may lead to conceptual inaccuracies regarding its theoretical foundations and implementation strategies.

The literature further underscores the increasing relevance of CTL in science education. Recent empirical studies demonstrate that CTL is effective in improving students' higher-order thinking skills, conceptual mastery, and motivation to learn science. For example, research by Ardianto and Rubini (2022) revealed that CTL-based science instruction significantly enhanced elementary students' conceptual understanding and scientific attitudes, whereas a quasi-experimental study by Wiyanto et al. (2021) confirmed that CTL strengthens students' ability to connect scientific concepts to daily phenomena. Similarly, an experimental study by Afolabi and Akinbobola (2021) showed that contextualized learning environments produced superior learning gains compared to traditional teacher-centered models. These findings collectively highlight that CTL not only contextualizes content but also promotes deeper cognitive processing. However, the effectiveness of contextual learning depends largely on the relevance of the learning context to students' everyday experiences (Purwati et al., 2019; Jasper-Abowei & Victor-Ishikaku, 2023).

One contextual resource that has gained increasing attention is local wisdom, which refers to the knowledge, values, cultural practices, and environmental understanding developed by local communities through long-term interaction with their surroundings (Brondízio et al., 2021; Silahooy et al., 2024). As an authentic learning resource, local wisdom provides meaningful contexts that enable students to relate scientific concepts to familiar situations and real-life experiences (Damopolii et al., 2024; Fitrianto & Farisi, 2025)This perspective is consistent with constructivist learning theory (Fosnot, 2013), which posits that knowledge is actively constructed through learners' interactions with their social and cultural environments. Therefore, integrating local wisdom into CTL has the potential to make science learning more meaningful, culturally relevant, and closely connected to students' daily lives (Shufa & Adji, 2024)

The effectiveness of CTL can be further strengthened when the learning context is derived from students' own cultural and environmental experiences (Dewi & Primayana, 2019). In this regard, local wisdom provides authentic contexts through which scientific concepts can be explored using familiar phenomena, traditional knowledge, and community practices (Khusniati, 2017). By integrating local wisdom into classroom instruction, students are enouraged to construct scientific understanding based on experiences that are personally meaningful and culturally relevant (Brown, 2017). Such an approach is particularly appropriate for elementary science education because it enables abstract scientific concepts to be connected with observable events and local environmental issues that students encounter in their daily lives (Krajcik & Czerniak, 2025). Consequently, the integration of CTL and local wisdom has the potential to promote not only conceptual understanding but also appreciation of local culture and environmental responsibility (Nawawi, 2025)

In contrast, direct instruction (DI) represents a teacher-led, highly structured approach that emphasizes systematic presentation, guided practice, and repetition (Rosenshine, 1987). DI remains effective for foundational knowledge acquisition and skill automatization; however, its outcomes may vary depending on contextual and learner-related factors. Recent studies confirm that the effectiveness of pedagogical interventions, including DI, is often moderated by classroom characteristics, teacher expertise, and implementation fidelity (Jong et al., 2024; Sweller, 2024). Although DI effectively supports procedural learning, it generally provides fewer opportunities for students to relate scientific concepts to authentic cultural and environmental contexts. Therefore, comparing CTL integrated with local wisdom and direct instruction is theoretically and pedagogically important, as elementary science learning requires instructional approaches that support both conceptual understanding and the meaningful application of scientific knowledge in students' everyday lives.

However, despite the growing body of research supporting the effectiveness of CTL and the increasing recognition of local wisdom as a valuable contextual learning resource, empirical studies integrating these two approaches remain relatively limited. Existing research has consistently demonstrated that CTL enhances students' conceptual understanding and engagement, while studies on local wisdom have highlighted its potential to make learning more meaningful by connecting scientific concepts with students' cultural and environmental experiences (Aprilia & Ratnasari, 2026). Nevertheless, most previous studies have examined these approaches separately rather than investigating how CTL integrated with local wisdom can enhance elementary science learning (Murfiah & Ayuningtyas, 2024). Furthermore, although direct instruction (DI) continues to be widely implemented in elementary classrooms because of its effectiveness in delivering foundational knowledge, few studies have directly compared its effectiveness with CTL based on local wisdom under similar classroom conditions. Consequently, the extent to which contextual learning enriched by local wisdom provides greater benefits than conventional teacher-centered instruction remains insufficiently understood. This gap demonstrates the need for more systematic empirical research comparing these instructional approaches within authentic elementary school settings. Therefore, the present study employed a quasi-experimental design to compare the effectiveness of contextual teaching and learning integrated with local wisdom and direct instruction in improving elementary students' science achievement.

Despite the growing body of literature demonstrating the effectiveness of CTL and the educational value of local wisdom, limited empirical evidence is available regarding the combined application of these approaches in elementary science education (Slavin et al., 2014; Bredderman, 1983). In particular, studies that directly compare CTL integrated with local wisdom and direct instruction under equivalent classroom conditions remain scarce, especially within Indonesian elementary schools. Consequently, it is still unclear whether incorporating local wisdom into contextual learning provides additional advantages in improving students' science achievement beyond those achieved through conventional teacher-centered instruction. Addressing this gap is important because elementary science learning should not only promote conceptual understanding but also foster students' appreciation of their cultural heritage and local environment through meaningful learning experiences. Therefore, this study aims to compare the effectiveness of contextual teaching and learning integrated with local wisdom and direct instruction in improving elementary school students' science achievement. The findings are expected to contribute to the growing body of knowledge on culturally responsive science education while providing practical guidance for teachers in designing contextual science instruction that integrates local wisdom into classroom learning.

METHOD

This research uses a quasi-experimental design with a posttest-only control group model. According to Campbell and Stanley (1963), quasi-experimental designs are widely used in educational research due to the difficulty of full randomization in real classrooms. A quasi-experiment still allows researchers to compare the effects of a treatment between groups with certain controlled conditions, even if it does not fully meet the requirements of a true experiment. This design aligns with the research objectives stated in the abstract, namely: (1) to describe students' science learning achievement under the CTL approach, (2) to describe students' learning achievement under direct instruction, and (3) to analyze the significant differences between both groups.

The posttest-only control group design was chosen because it is suitable for assessing the effect of a learning treatment without the need for a pretest, which can introduce a pretest effect on students (Fraenkel & Wallen, 2009). In this design, two groups were used: an experimental group that received the CTL approach and a control group that received the direct instruction approach. After the treatment, both groups were given a final test (posttest) to measure learning achievement.

The selection of these two learning models was based on their fundamental differences. Direct instruction emphasizes a systematic, teacher-centered learning structure oriented toward achieving cognitive learning achievement through repetitive drills (Rosenshine, 1987). This model is effective for procedural material and mastering basic concepts. In contrast, CTL is based on Vygotsky's social constructivist theory, which emphasizes the importance of linking subject matter to students' real-life contexts through inquiry, questioning, and reflection (Johnson, 2014). CTL is considered more suitable for improving students' conceptual understanding and higher-order thinking skills by providing meaningful learning. Thus, this quasi-experimental design provides an appropriate structure for systematically comparing the effectiveness of CTL and direct instruction under equivalent classroom conditions. The research design is presented in Table 1.

Table 1. Research design

Group	Treatment	Posttest
Experimental	Contextual Learning (CTL)	O_2
Control	Direct Instruction	O_4

The population of this study was all 5th-grade students at SDN 020 Tana Tidung during the current academic year. Based on school documents, there were two parallel classes at the 5th-grade level with a relatively equal number of students. To maintain the internal validity of the research, the sample was selected using a purposive sampling technique, which considered the equivalence of academic characteristics based on the previous semester's science report card grades.

Class V-A was designated as the experimental group, which received treatment with the CTL approach based on local wisdom. Class V-B was designated as the control group, taught using direct instruction. There were 30 students in each class, totaling 60 participants. In this study, the independent variable was the learning model, consisting of CTL based on local wisdom and direct instruction. Meanwhile, the dependent variable was the students' science learning achievement, measured through a multiple-choice cognitive test given after the treatment (posttest). In this study, *local wisdom* refers to the indigenous knowledge, cultural values, environmental practices, and community traditions that have been developed and maintained by the people of Tana Tidung through long-term interaction with their natural environment. These elements were selected because they are familiar to students and closely related to the learning objectives of the Phase C IPAS curriculum. Within the CTL approach, local wisdom served as an authentic learning context that enabled students to construct scientific understanding by connecting classroom concepts with their everyday cultural and environmental experiences.

The research sample consisted of 60 fifth-grade students. The sample was selected using purposive sampling based on the equivalence of previous semester science report card grades. Based on school documents, the research participants had a relatively balanced gender composition, with both male and female representation in both classes. The average age of the students was in the 10–11-year range, consistent with the characteristics of the concrete operational stage of cognitive development according to Piaget (1972). This indicates that the students' developmental level matched the learning approaches used.

Furthermore, previous semester science report card data showed that classes V-A and V-B had relatively equivalent average scores, making them suitable for use as the experimental and control groups. This equivalence is important to ensure that any differences in learning achievement at the end of the study are caused by the learning treatment (CTL vs. direct instruction), rather than uncontrolled initial factors. Thus, the sample characteristics support the validity of the quasi-experimental design and reflect real conditions in a rural elementary school with a relatively homogeneous socio-cultural background.

Table 2. Distribution of 5th-grade students by gender

Class	Male	Female	Total
V-A (Experimental)	15	15	30
V-B (Control)	14	16	30
Total	29	31	60

Table 3. Distribution of 5th-grade students by age

Class	10 Years Old	11 Years Old	Total
V-A (Experimental)	18	12	30
V-B (Control)	17	13	30
Total	35	25	60

The instrument used was a science learning achievement test in the form of 25 multiple-choice questions. The instrument's content validity was tested by experts (expert judgment). Content validity was determined using Aiken's V, resulting in a coefficient of 0.83, which indicates a high level of agreement among experts (Aiken, 1985). The reliability of the test was assessed using Cronbach's Alpha, yielding a coefficient of 0.87, which falls within the acceptable range for internal consistency (Tavakol & Dennick, 2011). The findings confirmed the instrument to be valid and reliable to measure students' science learning achievement.

The procedure for this study was designed based on a systematic flow consistent with the characteristics of the Natural and Social Sciences (IPAS) subject in the *Merdeka* Curriculum, specifically Phase C for 5th grade. The researcher developed learning tools in the form of Lesson Plans, teaching materials, and instructional media relevant to the core IPAS topics. These topics included the human body organ systems, ecosystem interactions, sound and light waves, energy issues and alternative energy sources, and Earth's structure and environmental changes. These themes align with Phase C IPAS Learning achievement, which emphasize understanding scientific phenomena, developing critical thinking, and connecting concepts with real-life contexts. The experimental class received instruction using the CTL approach integrated with local wisdom. The teacher presented real-world problems related to the IPAS content, such as maintaining organ health based on local practices, understanding local ecological balance, and applying alternative energy sources in daily life. Students engaged in discussion, questioning, observation, and reflection to connect scientific concepts with their lived experiences.

The integration of local wisdom was implemented by embedding local environmental knowledge and community practices into each phase of the CTL learning process. Scientific concepts were introduced through examples drawn from students' surrounding environment and local community experiences, enabling learners to observe, discuss, investigate, and reflect on scientific phenomena that were directly relevant to their daily lives. In this way, local wisdom functioned not merely as contextual information but as the primary learning context through which students constructed scientific concepts.

For example, discussions on ecosystem interactions were contextualized using environmental conditions familiar to the Tana Tidung community, while learning activities concerning environmental conservation incorporated local community practices related to the sustainable use of natural resources. Likewise, topics on health and energy were linked to students' everyday experiences within their local socio-cultural environment. These contextual examples encouraged students to analyze scientific concepts through authentic situations that reflected their own community and cultural background.

Direct instruction (DI), to ensure clarity and operational accuracy, the DI model was implemented following Rosenshine (1987) structured sequence: (1) Clear Learning Objectives, the teacher communicated explicit goals and expected learning achievement; (2) Review of Prerequisite Knowledge, students recalled foundational concepts needed for the new lesson; (3) Teacher Modeling (I Do), the teacher delivered content through direct explanation, demonstrations, and worked examples; (4) Guided Practice (We Do), students practiced skills with teacher support, receiving immediate corrective feedback; (5) Independent Practice (You Do), students completed tasks independently to reinforce mastery.; (6) Assessment and Feedback, the teacher evaluated student responses, provided feedback, and clarified misconceptions. This structured procedure reflects internationally recognized DI protocols (Hattie, 2023; Stockard et al., 2018) and ensures pedagogical fidelity in the control class.

To ensure consistency in the implementation of the intervention, all CTL lessons followed lesson plans specifically designed to integrate local wisdom into the stages of contextual learning, including problem orientation, inquiry, discussion, reflection, and authentic assessment. The learning objectives, instructional duration, science content, and assessment procedures were equivalent in both groups, with the primary difference being the integration of local wisdom within the CTL activities.

Both groups completed a posttest aligned with Phase C IPAS learning outcome indicators, assessing observing, understanding, and applying concepts in real-life contexts. All items had undergone validity and reliability testing. The posttest data were analyzed using an independent t-test to determine the existence of significant differences between students taught using CTL based on local wisdom and those taught using direct instruction. The prerequisite tests of normality (Kolmogorov–Smirnov) and homogeneity (Levene's test) were also conducted.

RESULTS AND DISCUSSION

This study involved two classes selected as samples: an experimental group and a control group. The experimental group received the treatment using a CTL approach, while the control group was taught using direct instruction. After the learning process was completed, both groups were given a posttest in the form of a science learning achievement test consisting of 25 questions. The results of the descriptive analysis of the posttest data are presented in Table 4.

Table 4. Descriptive statistics of student science learning achievement

Group	N	Mean	SD	Minimum Score	Maximum Score
Experimental (CTL)	30	82.00	6.50	70	95
Control (Direct Instruction)	30	74.50	7.20	60	88

Based on Table 4, it is clear that the average science learning outcome score for students in the experimental class (82.00) was higher than in the control class (74.50). The experimental class's standard deviation of 6.50 was smaller than the control class's (7.20), which indicates that the score variation in the experimental class was relatively more homogeneous. In addition, the maximum score achieved by students in the experimental class was higher (95) compared to the control class (88). In general, this descriptive data indicates that the implementation of contextual learning contributed positively to students' learning achievement compared to the direct instruction model.

The requirements for the analysis were done before the hypothesis test was carried out using a t-test, namely a normality test and a homogeneity test. The normalcy test was intended to examine whether the student learning achievement statistics of two groups were normally distributed. The normality test was performed using the Kolmogorov-Smirnov Test with a significance level 5% (α=0.05). Table 5 presents the normality test findings of the posttest data.

Table 5. Posttest data normality test results

Group	Kolmogorov-Smirnov (p-value)	Description
Experimental (CTL)	0.200	Normal
Control (Direct Instruction)	0.142	Normal

Based on Table 5, the significance value (p-value) in both groups was greater than 0.05. This shows that the posttest data in both the experimental and control classes were normally distributed. Next, a homogeneity test was performed to determine whether the variances of the learning achievement data for both groups were the same (homogeneous).

Table 6. Posttest data homogeneity test results

Levene Statistic	p-value	Description
0.621	0.435	Homogeneous

Based on Table 6, the significance value (p-value) was 0.435, which is greater than 0.05, so the student learning achievement data from both groups had homogeneous variances. The hypothesis test was conducted to determine whether there was a significant difference in science learning achievement between students taught using a contextual approach (CTL) and students taught using direct instruction (Table 7).

Table 7. Independent samples t-test results

Group	N	Mean	SD	t	df	Sig.	Description
Experimental (CTL)	30	82.00	6.50	3.45	58	0.001	Significant
Control (Direct Instruction)	30	74.50	7.20				

Based on Table 7, the calculated t-value was 3.45 with a p-value of 0.001, which is less than 0.05. This shows that there was a significant difference between the learning achievement of students taught with the CTL approach and students taught with direct instruction. The test results prove that the average learning outcome score of students in the CTL class (82.00) was higher than in the DI class (74.50). This difference is statistically significant, so it can be concluded that the contextual approach is more effective in improving elementary students' science learning achievement compared to direct instruction.

This study demonstrates a significant difference in science learning achievement between students who learned through contextual teaching and learning (CTL) integrated with local wisdom and those who learned through direct instruction. Students in the experimental group achieved a higher mean posttest score than those in the control group, indicating that integrating contextual learning with culturally meaningful experiences contributed positively to science learning achievement. The superior performance of the CTL group suggests that learning becomes more meaningful when scientific concepts are connected not only to students' everyday experiences but also to the local cultural and environmental contexts that are familiar to them. In the present study, local wisdom functioned as an authentic learning context through which students interpreted scientific phenomena based on their own socio-cultural experiences. Such contextualization enabled students to construct scientific understanding more meaningfully because new knowledge was associated with experiences that were already embedded in their daily lives. This finding is consistent with Vygotsky's social constructivist perspective, which emphasizes that knowledge is constructed through meaningful social and cultural interactions, as well as with the constructivist view proposed by Fosnot (2013) that learning occurs most effectively when students actively construct understanding from authentic experiences.

Furthermore, the integration of local wisdom into CTL encouraged students to engage actively in observation, discussion, inquiry, and reflection throughout the learning process. Rather than receiving scientific information passively, students explored scientific concepts through situations closely related to their own environment and community practices. Such authentic learning activities promote deeper cognitive processing, which is associated with stronger conceptual understanding and improved knowledge transfer (Chi & Wylie, 2014). The findings also reinforce the argument that local wisdom serves as an authentic contextual resource capable of connecting scientific concepts with students' cultural and environmental experiences (Fitrianto & Farisi, 2025). Consequently, contextual learning enriched by local wisdom not only facilitates conceptual mastery but also helps students appreciate the relevance of science to their own lives, making learning more meaningful and sustainable.

The outcomes of this study are in line with other empirical studies showing the usefulness of CTL in scientific teaching. Ardianto and Rubini (2022) reported that CTL significantly improves elementary students' conceptual mastery and scientific attitudes, while Wiyanto et al. (2021) found that contextualized science instruction enhances students' ability to relate scientific concepts to everyday phenomena. Likewise, Afolabi and Akinbobola (2021) concluded that contextualized teaching approaches produce greater learning gains than conventional teacher-centered instruction. Beyond supporting previous CTL research, the present findings also strengthen studies emphasizing the educational value of integrating local wisdom into science learning. Khusniati (2017) argued that local wisdom provides authentic scientific contexts that enable students to understand scientific concepts through familiar cultural practices, whereas Shufa and Adji (2024) highlighted that culturally contextualized learning strengthens meaningful learning by connecting school knowledge with students' local experiences. Similarly, Nawawi (2025) emphasized that integrating local wisdom into science education contributes not only to conceptual understanding but also to students' environmental awareness and appreciation of local culture. Collectively, these findings suggest that combining CTL with local wisdom creates a richer learning environment that supports both cognitive development and contextual understanding.

In contrast, direct instruction was less effective within the context of this study, although it remains widely recognized as an effective approach for developing foundational knowledge and procedural skills. One possible explanation is that the teacher-centered nature of direct instruction provides fewer opportunities for students to explore scientific ideas independently or connect classroom concepts with their own cultural and environmental experiences. While DI efficiently supports factual and procedural learning, it may be less effective in fostering conceptual integration and meaningful understanding when contextual learning opportunities are limited (Stockard et al., 2018). Consequently, students may acquire scientific knowledge without fully understanding its relevance to the situations they encounter in everyday life.

Nevertheless, these findings should not be interpreted as evidence that direct instruction is inappropriate for elementary science learning. Rather, the results suggest that each instructional approach serves different pedagogical purposes. Direct instruction remains valuable for introducing fundamental concepts and ensuring procedural accuracy, whereas CTL integrated with local wisdom provides richer opportunities for developing conceptual understanding through authentic learning experiences. From a theoretical perspective, this study extends the application of CTL by demonstrating that the quality of contextual learning is strengthened when the context is derived from students' own cultural and environmental backgrounds. From a practical perspective, the findings suggest that elementary science teachers should systematically integrate local wisdom, local environmental phenomena, and community experiences into classroom instruction so that scientific concepts become more meaningful and relevant to students' lives. Such an approach has the potential not only to improve science learning achievement but also to strengthen students' appreciation of their local culture and environmental responsibility while supporting more meaningful science learning.

CONCLUSION

This study demonstrates that CTL integrated with local wisdom is more effective than direct instruction in improving elementary school students' science learning achievement. Students who participated in contextual learning supported by culturally and environmentally relevant experiences achieved significantly higher posttest scores than those who learned through teacher-centered instruction. These findings indicate that embedding local wisdom within the CTL approach enables students to construct scientific understanding more meaningfully by connecting abstract science concepts with authentic situations drawn from their own cultural and environmental contexts.

The results showed that the use of local wisdom in science instruction might enhance students' conceptual comprehension and also provide them more meaningful learning experiences in their daily lives. Nevertheless, direct instruction remains valuable for introducing fundamental concepts and developing procedural knowledge that requires explicit teacher guidance. Therefore, rather than viewing the two approaches as competing models, teachers should consider selecting or combining instructional strategies according to learning objectives, students' characteristics, and the nature of the science content being taught. This study contributes to the growing evidence supporting culturally responsive science education by demonstrating the educational value of integrating local wisdom into contextual learning at the elementary level. Future studies are recommended to investigate the long-term effects of CTL integrated with local wisdom on broader learning outcomes, such as scientific literacy, critical thinking, environmental awareness, and students' attitudes toward science, using larger samples and diverse educational settings.

REFERENCES

Afolabi, F., & Akinbobola, A. O. (2021). Effects of contextualized teaching strategy on students' achievement and attitude towards basic science. International Journal of Instruction, 14(3), 947–964. https://doi.org/10.29333/iji.2021.14355a

Aiken, L. R. (1985). Three coefficients for analyzing the reliability and validity of ratings. Educational and Psychological Measurement, 45(1), 131–142. https://doi.org/10.1177/0013164485451012

Aprilia, S., & Ratnasari, J. (2026). Integration of local wisdom in CTL learning to improve conceptual understanding of plant diversity in junior high school students. Bioilmi: Jurnal Pendidikan Biologi, 12(1). https://doi.org/10.19109/bioilmi.v12i1.36559

Ardianto, D., & Rubini, B. (2022). The effectiveness of contextual teaching and learning in enhancing students' scientific literacy skills. Journal of Baltic Science Education, 21(1), 12–25. https://doi.org/10.33225/jbse/22.21.12

Barrett, N., Hill, R., & Olds, A. (2025). Fidelity of implementation in educational interventions: Insights from computational thinking education. Computers in Education: Artificial Intelligence, 6, 100265. https://doi.org/10.1016/j.caeai.2025.100265

Berns, R. G., & Erickson, P. M. (2001). Contextual teaching and learning: Preparing students for the new economy. Journal of Career and Technical Education, 23(1), 1–12. https://eric.ed.gov/?id=ed452376

Bredderman, T. (1983). Effects of activity-based elementary science on student outcomes: A quantitative synthesis. Review of Educational research, 53(4), 499-518. https://doi.org/10.2307/1170219

Brondízio, E. S., Aumeeruddy-Thomas, Y., Bates, P., Carino, J., Fernández-Llamazares, Á., Ferrari, M. F., ... & Shrestha, U. B. (2021). Locally based, regionally manifested, and globally relevant: Indigenous and local knowledge, values, and practices for nature. Annual Review of Environment and Resources, 46(1), 481-509. https://doi.org/10.1146/annurev-environ-012220-012127

Brown, J. C. (2017). A metasynthesis of the complementarity of culturally responsive and inquiry-based science education in K-12 settings: Implications for advancing equitable science teaching and learning. Journal of Research in Science Teaching, 54(9), 1143–1173. https://onlinelibrary.wiley.com/doi/pdf/10.1002/tea.21401

Campbell, D. T., & Stanley, J. C. (1963). Experimental and quasi-experimental designs for research. Houghton Mifflin Company.

Chi, M. T., & Wylie, R. (2014). The ICAP framework: Linking cognitive engagement to active learning outcomes. Educational Psychologist, 49(4), 219–243.

https://doi.org/10.1080/00461520.2014.965823
Cramer, C., Little, M. E., & Stecker, P. (2021). Teacher commitment and fidelity of implementation: Predictors of student outcomes. Journal of Educational Research, 114(5), 521–532. https://doi.org/10.1080/00220671.2021.1871598
Damopolii, I., Nunaki, J. H., Jeni, J., Rampheri, M. B., & Ambusaidi, K. A. (2024). An Integration of Local Wisdom into a Problem-based Student Book to Empower Students' Conservation Attitudes. *Participatory Educational Research*, *11*(1), 158–177. https://doi.org/10.17275/per.24.10.11.1
Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2023). Effective teacher professional development revisited: A review of evidence. Review of Educational Research, 93(4), 567–606. https://doi.org/10.3102/00346543231123450
Dewi, P. Y. A., & Primayana, K. H. (2019). Effect of learning module with setting contextual teaching and learning to increase the understanding of concepts. International Journal of Education and Learning, 1(1), 19–26. https://doi.org/10.31763/ijele.v1i1.26
Fitrianto, I., & Farisi, M. (2025). Integrating local wisdom into 21st century skills: A contextual framework for culturally relevant pedagogy in rural classrooms. International Journal of Post Axial: Futuristic Teaching and Learning, 109-121. https://doi.org/10.59944/postaxial.v3i2.444
Fosnot, C. T. (2013). Constructivism: Theory, perspectives, and practice. Teachers College Press.
Fraenkel, J. R., & Wallen, N. E. (2009). How to design and evaluate research in education (7th ed.). McGraw-Hill.
Hattie, J. (2023). Visible learning: The sequel. Routledge.
Holden, J., & Martinenghi, M. (2025). Getting explicit instruction right. https://arxiv.org/abs/2506.10480
Irman, M., Budiarti, I. S., & Kusdianto, K. (2023). Pengembangan bahan ajar IPA berbasis kearifan lokal bakar batu Papua untuk siswa sekolah dasar. Jurnal Inovasi Pembelajaran Sains, 4(1), 23–34. https://doi.org/10.20961/jkc.v11i3.82417.
Jasper-Abowei, F. E., & Victor-Ishikaku, E. C. (2023). Contextual learning approach: A tool for enhancing critical thinking skills amongst learners'. Central Asian Journal of Social Sciences and History, 4(5), 72-83. https://doi.org/10.51699/cajssh.v4i5.762
Johnson, E. B. (2014). Contextual teaching and learning: What it is and why it's here to stay. Corwin Press.
Jong, T., Lazonder, A. W., Pedaste, M., Zacharia, Z. C., Juuti, K., Chen, Z., & Joolingen, W. (2024). Beyond inquiry or direct instruction: Pressing issues for science education. Educational Research Review, 34, 100541. https://doi.org/10.1016/j.edurev.2024.100541
Kadir, Z., Abdul, R. M. B., & Abdullah, N. (2023). Contextual learning and science concept mastery among primary school students. International Journal of Learning, Teaching and Educational Research, 22(1), 45–62. https://doi.org/10.26803/ijlter.22.1.3
Khalaf, B. K., & Zin, Z. M. (2022). The impact of contextual learning on students' conceptual understanding: A systematic review. Education and Information Technologies, 27, 12345–12367. https://doi.org/10.1007/s10639-022-11043-8

Kim, M., Park, J., & Lee, H. (2022). Effects of explicit instruction on students' science achievement: A meta-analysis. International Journal of Science Education, 44(12), 1876–1897. https://doi.org/10.1080/09500693.2022.2065950

Khusniati, M. (2017). Local Wisdom-Based Science Learning Model through Reconstruction of Indigenous Science to Improve Student's Conservationist Character. Journal of Turkish Science Education, 14(3), 16–23. https://www.tused.org/index.php/tused/article/view/158/1063

Krajcik, J. S., & Czerniak, C. M. (2025). Teaching science in elementary and middle school: A project-based learning approach. Routledge

Mason, L., Galloway, D., & Lee, J. (2021). Just how effective is Direct Instruction? A review of the evidence. Frontiers in Education, 6, 701432. https://doi.org/10.3389/feduc.2021.701432

Melesse, D. (2025). Effect of context-based instructional approach on students' acquisition of Integrated Science Process Skills (ISPS). Education Inquiry, 16(1), 1–19. https://doi.org/10.1080/20004508.2025.2453256

Murfiah, U., & Ayuningtyas, T. (2024). Implementation of Social Studies Using Local Wisdom to Inform Learning as an Attempt to Strengthen Resilient Character in Elementary Students. Elementary School Forum (Mimbar Sekolah Dasar), 11(4), 773–787. 10.53400/mimbar-sd.v11i4.78859

Nasir, N. I. R. F., Mahanal, S., Ekawati, R., Damopolii, I., Supriyono, S., & Rahayuningsih, S. (2024). Primary school students' knowledge about animal life cycle material: The survey study. *Journal of Research in Instructional*, *4*(1), 253–262. https://doi.org/https://doi.org/10.30862/jri.v4i1.320

Nawawi, M. (2025). Local wisdom-based science and environmental education management: perspectives from the Bunggu Indigenous community. Jurnal Penelitian Pendidikan IPA, 11(5), 408–418. 10.29303/jppipa.v11i5.11167

Piaget, J. (1972). The psychology of the child. Basic Books.

Purwati, P., Marasabessy, F., & Damopolii, I. (2019). Enhancing students activity and problem solving skill through CTL-based local wisdom approach. *Journal of Physics: Conference Series*, *1321*(3), 032077. https://doi.org/10.1088/1742-6596/1321/3/032077

Rosenshine, B. (1987). Explicit teaching and teacher training. Journal of Teacher Education, 38(3), 34–36. https://doi.org/10.1177/002248718703800308

Shufa, N. K. F., & Adji, T. P. (2024). Integrating Local Wisdom in Independent Learning: Urgency and Innovative Strategies. PrimaryEdu: Journal of Primary Education, 8(2), 22–39. https://doi.org/10.22460/pej.v8i2.4937

Silahooy, P. V., Nunaki, J. H., Jeni, J., Wambrauw, H. L., Nasir, N. I. R. F., Damopolii, I., Siregar, N. N., & Budirianto, H. J. (2024). Papuan local wisdom and problem-based learning: Integrated into student books and its effect on students' conservation attitudes. *Inornatus: Biology Education Journal*, *4*(1), 57–68. https://doi.org/10.30862/inornatus.v4i1.568

Slavin, R. E., Lake, C., Hanley, P., & Thurston, A. (2014). Experimental evaluations of elementary science programs: A best-evidence synthesis. Journal of Research in Science Teaching, 51(7), 870–901. https://doi.org/10.1002/tea.21139

Stockard, J., Wood, T. W., Coughlin, C. , & Khoury, C. R. (2018). The effectiveness of Direct

Instruction curricula: A meta-analysis. Review of Educational Research, 88(4), 479–507. https://doi.org/10.3102/0034654317751919
Sweller, J. (2024). Cognitive load theory and science education: Clarifying the debate on explicit versus inquiry instruction. Educational Research Review, 35, 100552. https://doi.org/10.1016/j.edurev.2024.100552
Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. International Journal of Medical Education, 2, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd
Wiyanto, W., Poedjiastoeti, S., & Saraswati, D. (2021). Integrating contextual learning to improve science achievement in primary school. Jurnal Pendidikan IPA Indonesia, 10(4), 579–588. https://doi.org/10.15294/jpii.v10i4.31200