JELS Journal of Education and Learning Sciences
E-ISSN : 2808-3695

Vol 06 No 01 March 2026
http://jurnal.gerakanedukasi.com/index.php/gerasi
https://doi.org/10.56404/jels.v6i1.448

Effects of the Contextual Teaching and Learning Model on Mathematical Literacy and Learner Autonomy among Fourth-Grade Students at SD Negeri 13 Andoolo

[1]Nur Haizah aopmonaim, [2]Putri Ayu Purnamasari, [3]Waode Ekadayanti, [4]Itsnain Alfajri Husain

[1,2,3,4]Universitas Sulawesi Tenggara, Indonesia

[1]nurhaizaam@gmail.com, [2]putriayuxxxx@gmail.com, [3]waodeekadayanti@gmail.com, [4]itsalfajri@gmail.com

ABSTRACT: Mathematical literacy and learner autonomy are essential for enabling elementary school students to apply mathematical ideas in meaningful contexts and manage their own learning. This study examined changes in both outcomes following the implementation of the Contextual Teaching and Learning (CTL) model among fourth-grade students at SD Negeri 13 Andoolo. A quantitative pre-experimental approach using a one-group pretest-posttest design was employed. The sample comprised 13 students. Mathematical literacy was measured using a five-item constructed-response test, whereas learner autonomy was assessed using a 20-item Likert-scale questionnaire. The data were analyzed using descriptive statistics, assessed for normality with the Shapiro-Wilk test, and examined through paired-samples t-tests at the .05 significance level. Mean mathematical literacy scores increased from 47.69 to 80.38, while mean learner autonomy scores increased from 53.77 to 72.46. Both paired comparisons produced an SPSS significance output of 0.000 ($p < .001$). These findings indicate significant pretest-posttest improvements following the implementation of CTL; however, the absence of a control group limits causal interpretation.

Keywords: Mathematical, Education, Literacy, Teaching

INTRODUCTION

Mathematical literacy is the ability to use mathematical concepts, procedures, facts, and reasoning to formulate, apply, and interpret problems in diverse contexts. At the elementary school level, this ability is important because students begin to move beyond computation toward using mathematics to interpret information, select strategies, explain their reasoning, and make simple decisions. Higher Order Thinking Skills (HOTS)-based mathematics problems also require students to understand the context before performing operations; therefore, procedural mastery alone is insufficient (Salsabilla & Hidayati, 2021). Mathematics instruction should consequently provide opportunities for students to connect symbols and operations with experiences they can recognize.

Vol 06 No 01 March 2026
http://jurnal.gerakanedukasi.com/index.php/gerasi
https://doi.org/10.56404/jels.v6i1.448

Problems arise when instruction focuses excessively on procedural examples, formula memorization, and single correct answers without discussing the meaning of the problem. Under such conditions, concepts may seem abstract, and students may struggle when the form of a problem changes or when it is presented in an everyday context. Contextual instruction has been used to strengthen elementary school students' understanding of mathematical concepts by linking content to real-life experiences that serve as a basis for their thinking (Dharmayanti, 2019). The challenge is not merely to ensure that students obtain the correct answer, but also to help them explain the relationships among information, concepts, strategies, and solutions.

Successful mathematics learning is also influenced by learner autonomy. Autonomy does not mean learning without assistance; rather, it involves taking initiative, assuming responsibility for tasks, attempting to overcome difficulties, and sustaining engagement in the learning process. Nurfadilah and Hakim (2019) identify autonomy as an important component of mathematics learning because students must manage their actions while understanding problems and evaluating solutions. At the elementary school level, these habits should be developed through activities that offer choices of strategies, opportunities to ask questions, shared responsibility in group work, and individual reflection. Rizka's (2024) study also demonstrates the relevance of learner autonomy for elementary school students in a continually changing learning environment.

One model aligned with these needs is Contextual Teaching and Learning (CTL). CTL connects academic content with real-life contexts so that students construct understanding through meaningful experiences. Learning extends beyond the transmission of information and positions students as active participants who observe, question, discover, discuss, model, reflect, and demonstrate their abilities through authentic assessment. Muhartini et al. (2023) explain that contextual learning allows real-life experiences to serve as a basis for constructing understanding. Conceptually, therefore, CTL has the potential to address cognitive and dispositional dimensions simultaneously: students use mathematics to solve problems while learning to regulate their engagement throughout the process.

The seven components of CTL provide pedagogical mechanisms relevant to the two outcomes examined in this study. Constructivism helps students connect prior knowledge with new concepts; inquiry encourages them to identify patterns and develop strategies; questioning facilitates the clarification of information; the learning community enables the exchange of ideas; modeling demonstrates how problems can be represented; reflection helps students evaluate their thinking processes; and authentic assessment situates their abilities within meaningful tasks. This framework prevents mathematical literacy and learner autonomy from being treated as separate outcomes. When students solve contextual problems, they simultaneously practice selecting steps, seeking assistance appropriately, justifying their answers, and revising their strategies.

Previous findings support this potential, although their research foci and participants have varied. Astuti et al. (2025) reported an effect of CTL on mathematical literacy when examined in relation to learning interest, whereas Dharmayanti (2019) demonstrated improved conceptual understanding through contextual learning among elementary school students. Regarding learning dispositions, Bukit (2022) concluded that a contextual approach contributes to learner autonomy, and Ratnasari and Nasrullah (2022) found increased autonomy in mathematics learning through CTL. Nurjanah et al. (2025) also emphasized the relevance of contextual problems to the development of mathematical critical thinking. Collectively, these findings suggest that CTL can strengthen both students' ability to use mathematics and their capacity to manage the learning process.

Nevertheless, the literature review in the source thesis indicates that previous studies have more often examined mathematical literacy and learner autonomy separately and have involved students at different educational levels or with different characteristics. The present study addresses this issue by measuring both outcomes in the same group of fourth-grade students at SD Negeri 13 Andoolo before and after CTL was implemented. Their simultaneous measurement allows changes in cognitive ability and learner autonomy to be examined side by side. However, the one-group design does not include a comparison group; therefore, the results should be interpreted as changes observed after the intervention rather than as causal evidence that fully rules out other factors.

Based on these considerations, this study aimed to analyze differences in the mathematical literacy and learner autonomy of fourth-grade students at SD Negeri 13 Andoolo before and after the implementation of the Contextual Teaching and Learning model. The findings are expected to provide an empirical basis for teachers to design mathematics instruction that is more contextual and active and that supports students' responsibility for learning.

METHOD

This study employed a quantitative pre-experimental approach. A one-group pretest-posttest design was used, in which one group completed an initial assessment

(O1), received instruction using CTL (X), and completed a final assessment (O2). This design was selected because conditions at SD Negeri 13 Andoolo allowed only one class to serve as the research sample. Pre-experimental research can be used to observe changes after an intervention, but it provides less control than experiments involving a comparison group (Arib et al., 2024). Accordingly, the term effect in this study was operationalized as a significant difference between pretest and posttest scores following the implementation of CTL.

The study was conducted at SD Negeri 13. The population comprised all 13 students in the fourth grade, all of whom were included in the sample. The independent variable was the Contextual Teaching and Learning model, while the dependent variables were mathematical literacy and learner autonomy.

Data were collected through a test and a questionnaire. The mathematical literacy test consisted of five constructed-response items based on contextual problems. Its blueprint covered the abilities to interpret mathematics to solve problems, formulate problems mathematically, and use mathematical concepts, facts, procedures, and reasoning; the indicators were developed with reference to Salsabilla and Hidayati (2021). Learner autonomy was measured using a 20-item Likert-scale questionnaire covering four indicators: taking responsibility for learning, being active and creative, being able to solve learning problems, and maintaining consistency in learning. The questionnaire indicators were developed with reference to Rizka (2024). The use of both a test and a questionnaire enabled ability and learning-disposition data to be collected systematically (Jailani, 2023).

The research procedure began with the administration of a mathematical literacy pretest and an initial learner autonomy questionnaire to the 13 students. The students then participated in mathematics lessons using CTL, which connected the content to everyday contexts and incorporated inquiry, questioning, discussions within a learning community, modeling, reflection, and authentic assessment. After the instructional sequence, the students completed a posttest and a final questionnaire based on the same indicators. The analysis began with descriptive statistics, including total scores, minimum scores, maximum scores, and pretest and posttest means. The normality of each score distribution was assessed using the Shapiro-Wilk test because the sample included fewer than 30 participants. A homogeneity test was not conducted because only one group was measured repeatedly. After all data met the normality assumption, mean differences were analyzed using paired-samples t-tests at a significance level of .05 with SPSS version 20. A paired test was used to compare two measurements obtained from the same participants (Subekti et al., 2021). An SPSS output of 0.000 was interpreted as $p < .001$ rather than as a probability exactly equal to zero.

RESULTS AND DISCUSSION

Results

The analysis included 13 complete pairs of observations. Descriptively, posttest scores for both variables were higher than their respective pretest scores. As summarized in Table 1, the mean mathematical literacy score increased by 32.69 points, whereas the mean learner autonomy score increased by 18.69 points. The score ranges for both outcomes also shifted upward.

Table 1. Summary of Pretest and Posttest Scores

Variable	n	Pretest M (min.-max.)	Posttest M (min.-max.)	Mean increase
Mathematical literacy	13	47.69 (40-55)	80.38 (75-85)	32.69
Learner autonomy	13	53.77 (50-58)	72.46 (68-76)	18.69

For mathematical literacy, the total score increased from 620 to 1,045. The minimum score rose from 40 to 75, and the maximum score increased from 55 to 85. For learner autonomy, the total score increased from 699 to 942; the minimum score rose from 50 to 68, while the maximum score increased from 58 to 76. These descriptive findings demonstrate a consistent upward shift across the score distributions, rather than a change limited to the mean values.

The Shapiro-Wilk test was applied to the four score distributions. As shown in Table 2, all significance values exceeded .05. Therefore, the pretest and posttest scores for both variables met the normality assumption, and the analysis proceeded using paired-samples t-tests.

Table 2. Shapiro-Wilk Normality Test Results

Variable	Measurement	W	p	Decision
Mathematical literacy	Pretest	0.993	1.000	Normal
Mathematical literacy	Posttest	0.956	0.687	Normal

Variable	Measurement	W	p	Decision
Learner autonomy	Pretest	0.948	0.572	Normal
Learner autonomy	Posttest	0.926	0.303	Normal

The paired-test results are presented in Table 3, with differences calculated as pretest minus posttest. For mathematical literacy, a mean difference of -32.692 yielded t(12) = -99.713 and a significance output of 0.000. For learner autonomy, a mean difference of -18.692 yielded t(12) = -71.143, with a significance output of 0.000. The negative signs indicate that the pretest scores were lower than the posttest scores. At the .05 significance level, the null hypotheses for both variables were rejected; significant pretest-posttest differences were observed following the implementation of CTL.

Table 3. Paired-Samples t-Test Results

Pair	Mean difference (pre-post)	SD of difference	95% CI	t (df)	p
Mathematical literacy	-32.692	1.182	[-33.407; -31.978]	-99.713 (12)	0.000 *
Learner autonomy	-18.692	0.947	[-19.265; -18.120]	-71.143 (12)	0.000 *

*Note. *An SPSS output of 0.000 is interpreted as p < .001.*

Discussion

Improvement in Mathematical Literacy

The increase in the mean mathematical literacy score from 47.69 to 80.38 indicates that, following CTL instruction, students were more successful in solving context-based mathematics problems. The increase in the minimum score from 40 to 75 shows that the improvement was not confined to students with high initial scores. Substantively, this pattern suggests growth in students' abilities to identify relevant information, construct mathematical representations, apply procedures, and interpret their results in relation to the problem context.

The characteristics of CTL help explain this change. During the constructivist stage, everyday experiences serve as a bridge between prior knowledge and new concepts. Rather than confronting symbols detached from meaning, students examine familiar situations to identify quantitative relationships. This process is consistent with Muhartini et al. (2023), who emphasize the role of real-life experience in contextual learning, and with Dharmayanti's (2019) finding that a contextual approach supports elementary school students' understanding of mathematical concepts. When concepts are understood through meaningful situations, students have a stronger foundation for selecting operations and explaining the reasons for using them.

The inquiry and questioning components are also directly related to mathematical literacy processes. Inquiry requires students to observe, identify what is known and what is being asked, try strategies, and verify the suitability of their results. Questions posed by teachers and students help reveal assumptions and reasoning that would otherwise remain implicit. Through this process, mathematical problem solving is treated not as a mechanical sequence but as an activity of formulating and testing ideas. The relevance of contextual problems to the development of critical thinking and problem-solving skills is also emphasized by Nurjanah et al. (2025).

The learning community provides students with opportunities to compare representations and strategies. Peer explanations can demonstrate that a problem may be solved in more than one way, while modeling by teachers or students illustrates how a context can be translated into symbols, tables, diagrams, or calculations. These activities strengthen the communication and reasoning that form part of mathematical literacy. The present findings are consistent with Astuti et al. (2025), who found an effect of CTL on mathematical literacy, and extend that interpretation by demonstrating changes within the same group of fourth-grade students before and after the intervention.

Reflection and authentic assessment contribute to the consolidation stage. Reflection encourages students to review the strategies they used, identify errors, and formulate principles that can be transferred to other problems. Authentic assessment ensures that competence is evaluated not solely through memorization but through the application of concepts in tasks resembling real-life problems. Thus, the higher scores can be understood as the result of a sequence of experiences integrating context, discovery, communication, and self-evaluation.

Improvement in Learner Autonomy

The mean learner autonomy score increased from 53.77 to 72.46 following the implementation of CTL. This shift indicates changes in how students assumed responsibility, participated actively, addressed learning problems, and sustained their engagement. In this context, autonomy was not synonymous with working alone. Students could still discuss ideas and seek assistance, but such support was used purposefully to continue the learning process rather than to replace their own effort.

CTL positions students as active agents in learning. When teachers present contextual problems, students must activate prior knowledge, seek information, select strategies, and communicate their results. This sequence of decisions provides authentic practice in managing learning. Bukit (2022) showed that a contextual approach supports increased learner autonomy, while Nurfadilah and Hakim (2019) emphasized the importance of responsibility and self-management in mathematics learning. The present findings are consistent with this body of work because the increase in autonomy scores occurred alongside activities requiring student initiative.

The questioning component allows students to recognize what they do not yet understand and to articulate their learning needs. Inquiry develops persistence because answers are not always available on the first attempt. The learning community fosters individual responsibility within group work: each student must contribute ideas, listen to explanations, and be accountable for the outcome. Meanwhile, modeling provides initial support that can be gradually withdrawn as students become increasingly capable of working independently. These mechanisms help explain why active learning can build confidence without eliminating the teacher's role as a facilitator.

Reflection strengthens self-regulation. Through reflection, students evaluate what they have understood, which strategies were effective, and which areas require improvement. Authentic assessment subsequently provides feedback on both processes and outcomes, giving students information with which to plan their next efforts. Ratnasari and Nasrullah (2022) also reported increased learner autonomy through CTL in mathematics learning. Although their study was conducted at a different educational level, the consistency in the direction of the findings suggests that the interrelationship among context, meaningful activity, and student responsibility is relevant across educational levels.

Increased learner autonomy is also important for sustaining mathematical literacy. Students who demonstrate initiative and persistence are more likely to persevere when confronted with nonroutine problems, try alternative representations, and verify their answers. Conversely, successfully solving contextual problems can strengthen students' sense of competence and willingness to learn independently. This reciprocal relationship explains why measuring both variables simultaneously provides a more comprehensive picture than evaluating cognitive outcomes alone.

Research Implications and Limitations

Pedagogically, the findings encourage teachers to design mathematics instruction that begins with contexts familiar to students and then guides them toward formal representations and concepts. Teachers should balance support and autonomy: questions, models, and group work can be used as scaffolds that enable students to complete increasingly complex tasks. Brief reflection at the end of a lesson and authentic assessment should also be planned as core components rather than supplementary activities. These practices have the potential to sustain improvements in mathematical literacy while fostering responsible learning habits.

The findings must nevertheless be interpreted in light of the study's design limitations. The study involved only 13 students from one school and did not include a control group. Consequently, the pretest-posttest differences cannot rule out the effects of history, maturation, repeated testing, or other classroom factors that occurred concurrently with the intervention. The very large absolute t-values indicate that score differences were consistent within the sample, but they do not in themselves support generalization to other schools. Information concerning the timing and duration of the intervention, the sampling technique, and evidence of instrument validity and reliability should also be provided so that the study's replicability can be adequately assessed.

Future studies should include a comparison group, a larger number of schools and participants, and complete reporting of the instruments. A quasi-experimental design incorporating baseline measurement could help distinguish changes associated with CTL from variation in initial ability and external factors. Observations of the implementation fidelity of the seven CTL components could also be included to identify which components contribute most strongly to mathematical literacy and learner autonomy.

CONCLUSION

The implementation of Contextual Teaching and Learning in the fourth-grade class at SD Negeri 13 Andoolo was followed by significant improvements in mathematical literacy and learner autonomy. Students achieved higher posttest scores on both variables, and the paired-samples t-tests confirmed significant pretest-posttest differences at the .05 level. Pedagogically, real-life contexts, inquiry, questioning, the learning community, modeling, reflection, and authentic assessment provide experiences that enable students to use mathematics meaningfully while assuming greater responsibility for their learning. However, because the study used a single group of 13 students without a control group, its conclusions are limited to the changes observed after CTL implementation and are not intended as causal evidence independent of other factors.

Teachers may use CTL as an alternative approach to mathematics instruction by selecting contexts that are familiar to students and ensuring that all components are implemented systematically. Future research should include a comparison group, a broader sample, documentation of intervention fidelity, and evidence of instrument validity and reliability to strengthen the conclusions and improve the generalizability of the findings.

REFERENCES

Arib, M. F., Rahayu, M. S., Sidorj, R. A., & Afgani, M. W. (2024). Experimental research dalam penelitian pendidikan. *Innovative: Journal of Social Science Research, 4*(1), 5497–5511.

Astuti, G. D., Kurniawati, R. P., & Kusumawati, N. (2025). Pengaruh model pembelajaran Contextual Teaching Learning (CTL) terhadap literasi matematika ditinjau dari minat belajar siswa. *Pendas: Jurnal Ilmiah Pendidikan Dasar, 10*(3), 540–550.

Bukit, S. (2022). Implementasi pendekatan pembelajaran kontekstual dalam peningkatan kemandirian belajar siswa (studi literatur). *Jurnal Multidisiplin Madani, 2*(4), 1627–1638.

Dharmayanti, L. (2019). Penerapan pendekatan pembelajaran kontekstual untuk meningkatkan pemahaman konsep matematika pada siswa sekolah dasar kelas IV. *COLLASE (Creative of Learning Students Elementary Education), 2*(6), 240–244.

Jailani, M. S. (2023). Teknik pengumpulan data dan instrumen penelitian ilmiah pendidikan pada pendekatan kualitatif dan kuantitatif. *IHSAN: Jurnal Pendidikan Islam, 1*(2), 1–9.

Muhartini, M., Mansur, A., & Bakar, A. (2023). Pembelajaran kontekstual dan pembelajaran problem based learning. *Lencana: Jurnal Inovasi Ilmu Pendidikan, 1*(1), 66–77.

Nurfadilah, S., & Hakim, D. L. (2019). Kemandirian belajar siswa dalam proses pembelajaran matematika. *Prosiding Sesiomadika, 2*(1), 1214–1223.

Nurjanah, T., Prihaswati, M., & Purnomo, E. A. (2025). Systematic literature review: Meningkatkan kemampuan berpikir kritis matematika siswa dalam menyelesaikan masalah secara kontekstual. *Jurnal Pendidikan MIPA, 15*(1), 287–294.

Ratnasari, S., & Nasrullah, A. (2022). Meningkatkan kemampuan berpikir kreatif dan kemandirian belajar siswa SMA dengan model pembelajaran Contextual Teaching and Learning (CTL) pada materi peluang. *JPMI (Jurnal Pembelajaran Matematika Inovatif), 5*(6), 1675–1688.

Rizka, W. (2024). *Pengaruh literasi digital terhadap kemandirian belajar peserta didik kelas V SDN 1 Langkapura* [Doctoral dissertation, UIN Raden Intan Lampung].

Salsabilla, I., & Hidayati, Y. M. (2021). Kemampuan literasi matematika siswa kelas V dalam menyelesaikan soal matematika tipe Higher Order Thinking Skills (HOTS). *JKPD (Jurnal Kajian Pendidikan Dasar), 6*(1), 92–107.

Subekti, M. R., Wibowo, D. C., & Triani, S. (2021). Pengaruh penerapan pendekatan saintifik terhadap hasil belajar siswa pada pembelajaran tema 2 Selalu Berhemat Energi dan subtema 1 Sumber Energi pada siswa kelas IV SD Negeri 23 Menyumbung Sintang tahun ajaran 2019/2020. *Jurnal Studi Guru dan Pembelajaran, 4*(1), 39–48.