Elementary School Teachers' Pedagogical Practices in Deep Learning Oriented Toward Critical and Creative Thinking

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Abstract

The rapid transformation of twenty-first-century education requires learning processes that foster students' higher-order thinking skills, particularly critical and creative thinking. However, mathematics instruction in elementary schools often remains focused on procedural knowledge and answer-oriented learning. This study aims to explore teachers' pedagogical practices in implementing deep learning-oriented instruction in place value learning and to examine their contribution to the development of students' critical and creative thinking skills. A qualitative case study design was conducted in an elementary school involving a Grade V teacher, students, and school stakeholders. Data were collected through classroom observations, semi-structured interviews, and document analysis. The data were analyzed using an interactive qualitative approach consisting of coding, categorization, and interpretation. The findings reveal that deep learning principles were partially integrated into classroom practice through contextual learning activities, collaborative tasks, the use of concrete learning media, questioning strategies, and reflective activities. Students demonstrated emerging abilities to explain their reasoning, compare numerical values, and connect mathematical concepts to real-life situations. Nevertheless, the development of critical and creative thinking skills remained uneven and at an early stage. Furthermore, assessment practices were still predominantly focused on procedural accuracy, which limited opportunities for students to engage in deeper reasoning and problem-solving processes. In conclusion, deep learning-oriented instruction shows considerable potential for enhancing students' higher-order thinking skills in mathematics learning. However, its effectiveness depends on stronger alignment among lesson planning, instructional implementation, and assessment practices to support meaningful and sustained learning outcomes.

1. Introduction

The developments of the 21st century require education to focus not only on the acquisition of knowledge but also on the development of higher-order thinking skills, including critical and creative thinking. These skills are essential competencies that students need to navigate increasingly complex and dynamic global challenges (OECD, 2021; Pellegrino & Hilton, 2012). In elementary school mathematics education, critical thinking enables students to analyze information logically, while creative thinking allows them to generate multiple strategies for solving problems. Therefore, mathematics should not be viewed merely as a collection of computational procedures, but as a means of fostering logical, analytical, and creative reasoning for solving real-life problems (Facione, 2011; Wilson, 2016).

To improve the quality of mathematics instruction, various studies have demonstrated that deep learning, inquiry-based learning, and collaborative learning approaches have significant potential to foster Higher-Order Thinking Skills (HOTS). Deep learning emphasizes meaningful learning processes in which students actively construct understanding through conceptual connections and reflection on their learning experiences (Marton, 1979; Biggs & Catherine, 2022; Vincent-Lancrin et al., 2019). Furthermore, inquiry-based and collaborative learning have been shown to enhance critical thinking skills through exploration, discussion, and reflective processes (Roberts, 2006; Kirschner & Clark, 2006; Johnson & Johnson, 2009). In addition, tasks with high cognitive demand encourage students to engage in creative, analytical, and evaluative reasoning when solving mathematical problems (Stein et al., 2000; Lithner, 2015). A collaborative learning environment has also been found to promote students' creativity and innovation (Vincent-Lancrin et al., 2019; Hattie, 2008).

Nevertheless, the successful implementation of these approaches depends largely on teachers' pedagogical practices in the classroom. Research has shown that the quality of teacher–student interactions, scaffolding, and

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teachers' ability to facilitate meaningful learning are key factors in the development of Higher-Order Thinking Skills (HOTS) (Shulman, 1986; Loewenberg Ball et al., 2008). However, in practice, many teachers still focus primarily on learning outcomes rather than on students' thinking processes, even though process-oriented and metacognitive assessment play a crucial role in HOTS-based learning (Facione, 2011; Hattie, 2008). This situation indicates a gap between the theoretical principles of deep learning–based instruction and their actual implementation in classroom practice.

Several previous studies have highlighted the importance of implementing deep learning, inquiry-based approaches, and collaboration in mathematics education. Studies by Vincent-Lancrin et al. (2019) and Shulman (1986) emphasize the crucial role of teachers in facilitating dialogue, reflection, and collaboration to support meaningful learning. In addition, research by Stein et al. (2000) demonstrates that collaborative learning and cognitively demanding tasks can enhance students' thinking skills. However, these studies have primarily focused on learning outcomes or instructional models in general and have not specifically examined teachers' pedagogical practices in the context of teaching place value concepts in elementary schools.

Based on the reviewed literature, a significant research gap remains, namely the limited number of studies that explore teachers' pedagogical practices in a naturalistic context when implementing deep learning in the teaching of place value concepts. Existing studies have predominantly focused on instructional models or learning outcomes, while authentic classroom processes such as lesson design, facilitation of interactions, scaffolding practices, and the assessment of students' thinking processes are received relatively little in-depth attention (Loewenberg Ball et al., 2008). Therefore, there is a need for research that focuses more specifically on the actual practices of classroom instruction.

Based on these gaps, this study aims to explore in depth teachers' pedagogical practices in implementing deep learning–based instruction on place value concepts in fifth-grade elementary school classrooms. The focus of the study includes instructional design, teacher–student interactions, the use of questioning strategies, scaffolding practices, and the assessment of students' thinking processes. This research is expected to contribute theoretically to the advancement of deep learning and Higher-Order Thinking Skills (HOTS) scholarship, methodologically to the development of qualitative naturalistic research, and practically to improving the quality of mathematics instruction in elementary schools.

2. Method

This study employed a qualitative approach with a descriptive naturalistic design to explore teachers' pedagogical practices in implementing deep learning-oriented instruction to foster students' critical and creative thinking skills in place value learning in Grade V at an elementary school. A qualitative approach was considered appropriate because the study sought to gain an in-depth understanding of learning processes, classroom interactions, and participants' experiences within authentic educational settings without any experimental intervention. Guided by the interpretive-constructivist paradigm, the study viewed classroom realities as socially constructed through interactions among teachers and students and therefore examined these phenomena within their natural context (Corbin & Strauss, 2008; Creswell, 2018).

The research was conducted during the second semester of the 2025/2026 academic year at an elementary school. The participants consisted of one Grade V classroom teacher as the primary participant, 15 Grade V students as supporting participants, comprising 8 boys and 7 girls, and the principal and curriculum coordinator as key informants. Participants were selected using purposive sampling because they were directly involved in the planning, implementation, supervision, and evaluation of mathematics instruction. This sampling technique enabled the researcher to obtain rich and relevant information regarding the implementation of deep learning-oriented pedagogical practices (Creswell, 2018).

In qualitative research, the researcher served as the primary instrument responsible for collecting, interpreting, and analyzing the data. Supporting instruments included observation guidelines, semi-structured interview protocols, documentation review sheets, field notes, and reflective memos. The observation guidelines focused on pedagogical practices such as questioning techniques, scaffolding strategies, collaborative learning activities, reflective learning processes, student engagement, and assessment practices. Semi-structured interviews were conducted to explore participants' experiences, perceptions, instructional decisions, and reflections concerning the implementation of deep learning-oriented instruction (Bezanilla et al., 2019; Brookfield, 2020). Documentation analysis involved examining lesson plans, teaching materials, student worksheets, students' learning products, and assessment records. The credibility of the instruments was ensured through alignment between the research objectives, theoretical constructs, and data collection indicators, while the trustworthiness of the findings was strengthened through triangulation, member checking, prolonged engagement, and the maintenance of an audit trail throughout the research process (Gwet, 2021; Landis & Koch, 1977).

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Data were collected through classroom observations, semi-structured interviews, and documentation analysis. The research process consisted of three interrelated stages: preparation, implementation, and analysis. The preparation stage involved conducting preliminary observations, reviewing relevant literature, developing research instruments, and obtaining research permission. During the implementation stage, classroom observations of place value lessons were carried out, interviews were conducted with participants, and relevant instructional documents were collected and reviewed. Consistent with qualitative inquiry, data collection and preliminary analysis were conducted concurrently, allowing the researcher to refine observations, interview questions, and emerging interpretations throughout the study (Corbin & Strauss, 2008).

Data analysis followed the interactive qualitative analysis procedures proposed by Corbin & Strauss, (2008), which included data reduction, data display, coding, category development, interpretation, and conclusion drawing. Data obtained from observations, interviews, and documentation were systematically organized, coded, and categorized to identify recurring patterns and themes related to pedagogical practices that support the implementation of deep learning. To ensure credibility and contextual validity, findings were continuously verified through source triangulation, technique triangulation, member checking, and cross-source comparison. This iterative analytical process enabled the development of comprehensive, credible, and contextually grounded findings regarding teachers' pedagogical practices in implementing deep learning within elementary mathematics classrooms (Corbin & Strauss, 2008; Creswell, 2018).

3. Results and Discussion

3.1. Results

The findings of this study were obtained through classroom observations, in-depth interviews, and document analysis conducted during Grade V mathematics lessons on place value concepts at an elementary school. The data collection process was carried out during the second semester of the 2025/2026 academic year and involved the classroom teacher, students, principal, and curriculum coordinator. Supporting documents included teaching modules, student worksheets, assessment records, students' work, instructional media, and learning documentation. The findings are presented according to five main aspects: (1) deep learning-oriented lesson planning, (2) implementation of deep learning-oriented instruction, (3) pedagogical interactions and students' thinking skills, (4) assessment practices, and (5) challenges and teacher strategies in implementing deep learning.

3.1.1. Deep Learning-Oriented Lesson Planning

Document analysis and interview data showed that the teacher had prepared instructional components aligned with the principles of the Merdeka Curriculum, including teaching modules, student worksheets, concrete learning media, assessment activities, group discussions, and reflective questions. Learning objectives focused on understanding place value concepts, explaining reasoning, and solving mathematical problems through sequential procedures. During the interview, the teacher stated, "I try to design learning activities that do not only require students to calculate but also to explain the reasons behind their answers" (W/G/V/12-02-2026).

Several deep learning elements were identified in the lesson planning documents, as presented in Table 1.

Table 1. Deep Learning Elements Identified in Lesson Planning

No	Deep Learning Elements	Field Findings	Description
1	Triggering questions	Teacher connected the lesson with students' daily experiences	Learning activities began with contextual questions related to students' everyday experiences, such as money, house numbers, and daily numerical situations, to activate prior knowledge and stimulate curiosity.
2	Concept exploration	Students observed, arranged, and compared numbers	Students were engaged in activities involving observing number patterns, arranging digits, identifying place values, and comparing numbers to develop conceptual understanding through active exploration.
3	Concrete media	Teacher used number cards, place value boards, and numerical tables	Various manipulatives and visual representations were prepared to help students understand the relationship between digit position and numerical value through hands-on learning experiences.
4	Reflection	Reflective questions were provided at the end of lessons	Students were encouraged to review their learning experiences by responding to reflective questions about what they learned, how they solved problems, and the difficulties they encountered.
5	Group discussion	Students worked collaboratively in small groups	Students participated in collaborative activities where they discussed ideas, shared solutions, compared answers, and completed tasks collectively within small groups.

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Observation data showed that concrete learning media and discussion activities were used to support students' understanding of place value concepts. Contextual examples such as snack prices, house numbers, pocket money, vehicle numbers, and classroom population were incorporated into instructional activities. The learning media included colored number cards, place value boards, numerical tables, and color-coded number pieces for group activities.

Analysis of student worksheets indicated that most tasks emphasized procedural exercises and basic conceptual understanding. Assessment tasks primarily focused on obtaining correct answers. The components of deep learning identified in lesson planning documents are summarized in Table 2.

Table 2. Deep Learning Components in Lesson Planning

No	Learning Component	Research Findings	Description
1	Learning objectives	Focused on understanding place value concepts	Learning objectives emphasized students' understanding of place value concepts and their ability to identify the value of digits according to their positions.
2	Critical thinking activities	Triggering questions and group discussions	Lesson plans included guiding questions and collaborative discussions designed to encourage students to explain, analyze, and justify their answers.
3	Creative thinking activities	Students asked to provide alternative answers	Students were given opportunities to propose different solutions or strategies for solving mathematical tasks related to place value.
4	Learning media	Number cards and place value boards	Concrete instructional media were prepared to support conceptual understanding through visual and hands-on learning experiences.
5	Contextual learning	Connected to daily life situations	Learning activities were linked to familiar contexts such as money, house numbers, vehicle registration numbers, and everyday numerical situations.
6	Reflection	Conducted at the end of learning	Reflection activities were included to encourage students to review what they had learned and identify difficulties encountered during the lesson.
7	Student worksheets	Dominated by procedural exercises	Most worksheet tasks focused on identifying place values, arranging numbers, and completing routine exercises with limited opportunities for higher-order thinking.
8	Assessment	Focused on final answers	Assessment activities primarily evaluated the correctness of students' answers rather than their reasoning processes or problem-solving strategies.
9	HOTS questions	Limited in number	Questions requiring analysis, evaluation, justification, or multiple solution strategies appeared only in a small portion of learning activities.
10	Critical thinking indicators	Not explicitly formulated	Specific indicators for assessing students' critical thinking skills were not clearly stated in the lesson plans or assessment criteria.

3.1.2. Implementation of Deep Learning-Oriented Instruction

Classroom observations revealed that instruction began with contextual activities linking place value concepts to house numbers, snack prices, and students' daily experiences. During the core activities, the teacher utilized number cards and place value boards to illustrate the relationship between digit position and numerical value. Students were organized into small groups consisting of four to five members to arrange numbers, identify place values, compare numbers, and explain their answers.

The instructional activities observed during the learning process are presented in Table 3.

Table 3. Observed Learning Activities

No	Learning Activities	Observation Findings	Description
1	Triggering questions	Conducted at the beginning of lessons	The teacher initiated learning by asking contextual questions related to students' daily experiences to activate prior knowledge and stimulate thinking.
2	Group discussions	Students arranged and compared numbers	Students worked collaboratively in small groups to arrange numbers, determine place values, and compare numerical representations.
3	Concrete media	Supported understanding of place value concepts	Number cards, place value boards, and numerical tables were used to help students visualize relationships between digit position and value.
4	Idea exploration	Limited	Opportunities for students to generate multiple ideas or alternative solutions were observed but occurred infrequently.

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No	Learning Activities	Observation Findings	Description
5	Group presentations	Only several students actively participated	A small number of students presented discussion results, while others tended to remain passive during presentations.
6	Contextual learning	Connected with daily life situations	Learning activities incorporated examples such as money, house numbers, vehicle numbers, and everyday numerical situations.
7	Reflection	Conducted in a simple manner	The teacher concluded lessons with reflective questions about what students had learned and how they solved problems.
8	Independent learning	Students still required teacher guidance	Students attempted tasks independently but frequently sought clarification and support from the teacher.
9	Student participation	Uneven across students	Participation levels varied, with some students actively contributing while others rarely engaged in discussions or questioning.
10	Teacher dominance	Relatively high	The teacher remained the primary source of instruction and guidance throughout most learning activities and discussions.

Observation data also indicated that the teacher used questioning strategies, discussion activities, contextual examples, and reflective questions throughout the lesson. One classroom interaction recorded during observation was as follows: Teacher: "Why does the digit 5 in the number 5,432 have a different value from the digit 5 in the number 356?" Student: "Because it is in a different place." Students were observed explaining their answers and participating in collaborative discussions, although participation varied among individuals.

3.1.3. Pedagogical Interactions and Students' Thinking Skills

Observation and interview data showed that the teacher frequently used follow-up questions such as "Why do you think so?" and "Is there another way?" during classroom interactions. Several indicators of students' critical and creative thinking skills were identified during the learning process and are summarized in Table 4.

Table 4. Indicators of Students' Thinking Skills

No	Indicator	Findings	Description
1	Explaining reasoning	Emerging	Several students were able to explain the reasons behind their answers, although explanations were generally brief and required teacher prompting.
2	Comparing numbers	Observable	Students demonstrated the ability to compare numbers and identify differences in place value based on digit position.
3	Providing alternative answers	Demonstrated by some students	A number of students proposed different methods or solutions when arranging numbers and determining place values.
4	Drawing conclusions	Required teacher assistance	Most students needed guidance and questioning from the teacher to formulate mathematical conclusions independently.
5	Connecting concepts to real-life situations	Observable	Students related place value concepts to familiar contexts such as money, house numbers, and daily numerical information.
6	Expressing opinions confidently	Uneven among students	Some students actively shared their ideas, while others were hesitant to participate due to fear of making mistakes.
7	Explaining thinking processes	Relatively simple	Students could describe how they obtained answers, but their explanations were often limited to procedural steps.
8	Collaborative discussion	Developing	Students participated in group discussions, exchanged ideas, and worked together to solve assigned tasks.
9	Identifying errors	Emerging	Several students were able to recognize and correct mistakes in their own work or in peers' responses after discussion.
10	Independent strategies	Limited	Most students still relied on teacher guidance when solving mathematical problems independently.

Observation findings indicated that some students were able to explain the reasoning behind their answers and compare the value of digits according to their positions. Several students demonstrated alternative strategies when arranging numbers and identifying place values. Interview data also revealed students' preference for learning activities involving instructional media and group discussions. One student stated, "Learning with number cards is easier because we can see it directly" (W/S1/20-02-2026).

3.1.4. Assessment Practices in Deep Learning-Oriented Instruction

Document analysis and classroom observations showed that the teacher employed several forms of assessment, including written exercises, group assignments, observation of student participation, question-and-answer sessions, and reflective activities. The forms of assessment identified during the study are presented in Table 5.

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Table 5. Assessment Forms Used by the Teacher

No	Assessment Type	Findings	Description
1	Written exercises	Focused on answer accuracy	Written tasks primarily assessed students' ability to identify place values, arrange numbers, and determine digit positions correctly. Evaluation emphasized the correctness of final answers.
2	Group assignments	Assessed collaboration	Group tasks were used to evaluate students' participation, cooperation, and contribution during collaborative learning activities and problem-solving discussions.
3	Observation	Monitored student participation	The teacher observed students' engagement, responsiveness, interaction, and involvement during classroom activities, discussions, and learning tasks.
4	Question and answer	Assessed explanation of answers	Oral questioning was employed to examine students' understanding of concepts and their ability to explain the reasoning behind their answers.
5	Reflection	Encouraged awareness of learning processes	Reflective activities invited students to review what they had learned, identify difficulties encountered, and describe the strategies they used to solve problems.

During the interview, the teacher stated, "I usually assess students based on their work and answers, but now I have started to pay attention to how they explain their answers" (W/G/V/24-02-2026). Observation data indicated that most assessment activities focused on identifying place values, arranging numbers, and determining digit positions. Reflective questions such as "What did you learn today?" and "How did you find the answer?" were also observed at the end of lessons.

3.1.5. Challenges and Teacher Strategies in Implementing Deep Learning

Interview and observation data identified several challenges encountered during the implementation of deep learning-oriented instruction. These findings are presented in Table 6.

Table 6. Challenges in Implementing Deep Learning

No	Challenges	Field Findings	Description
1	Limited instructional time	Insufficient time for extended discussion and exploration	The available lesson duration was often insufficient to accommodate in-depth discussions, concept exploration, reflection activities, and comprehensive feedback for all students.
2	Diverse student abilities	Variations in participation and understanding	Differences in students' academic abilities and learning readiness resulted in unequal participation levels and varying degrees of conceptual understanding during classroom activities.
3	Limited critical thinking habits	Difficulty explaining reasoning processes	Many students were not accustomed to explaining the rationale behind their answers and often struggled to articulate their thinking processes clearly.
4	Answer-oriented learning culture	Focus on correct answers rather than reasoning	Students tended to prioritize obtaining correct answers rather than understanding concepts, exploring alternative solutions, or explaining their reasoning.
5	Limited HOTS assessment	Few analytical and reflective questions	Assessment activities contained only a limited number of tasks requiring analysis, evaluation, justification, problem-solving, or reflective thinking.
6	Low confidence in expressing opinions	Some students hesitant to respond publicly	Several students were reluctant to answer questions, participate in discussions, or present their ideas due to fear of making mistakes or being judged by peers.
7	Dependence on teacher guidance	Students frequently waited for teacher explanations	Students often relied on teacher instructions and examples before attempting tasks independently, indicating limited self-directed learning and problem-solving initiative.

The teacher reported, "If we want students to think more deeply, it requires more time" (W/G/V/24-02-2026). Several strategies were identified to address these challenges, as presented in Table 7.

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Table 7. Teacher Strategies in Implementing Deep Learning

No	Strategy	Field Findings	Description
1	Using concrete learning media	Number cards, place value boards, and numerical tables	The teacher utilized manipulatives and visual learning aids to help students understand place value concepts through direct observation, hands-on activities, and visual representation of numbers.
2	Organizing small-group discussions	Collaborative problem-solving activities	Students worked in small groups to discuss ideas, compare answers, solve problems collaboratively, and share their understanding with peers.
3	Providing gradual questioning	Questions ranging from simple to analytical	The teacher employed a sequence of questions beginning with basic comprehension and progressing toward explanation, reasoning, and analytical thinking to support students' cognitive development.
4	Motivating students	Verbal encouragement to increase confidence	Positive reinforcement and verbal encouragement were provided to build students' confidence in expressing opinions, answering questions, and participating in classroom discussions.
5	Connecting learning with daily life	Examples involving money, house numbers, and vehicles	The teacher linked mathematical concepts to familiar real-life situations to make learning more meaningful and easier for students to understand.
6	Conducting simple reflection	Reflective questions at the end of lessons	Students were asked to reflect on what they had learned, how they solved problems, and any difficulties encountered during the learning process to promote awareness of their own learning.

Observation data showed that concrete learning media were consistently used during instructional activities and that group discussions were integrated into classroom learning. School leaders also reported support for creative and student-centered instructional practices aligned with the Merdeka Curriculum.

Overall, the findings indicate that deep learning-oriented practices were present in lesson planning, instructional implementation, pedagogical interactions, assessment activities, and teacher strategies. The results presented above constitute the empirical findings of the study and provide the basis for further interpretation in the Discussion section.

3.2. Discussion

The findings of this study indicate that the implementation of deep learning–based instruction in place value content is not merely the application of a teaching strategy, but rather a closely interconnected process involving lesson planning, instructional delivery, pedagogical interactions, assessment practices, and instructional adaptation. Overall, the results suggest that teachers have begun to integrate several key characteristics of deep learning in mathematics instruction, such as contextual learning, concept exploration, collaborative activities, reflective questioning, and the use of concrete learning media. These findings support the conceptual framework. Vincent-Lancrin et al. (2019), which emphasizes that deep learning is oriented toward meaningful understanding, critical thinking, creativity, reflection, and the application of knowledge in real-world contexts. This condition indicates that the implementation of learning is in a transitional stage, as not all components are consistently and systematically integrated.

In line with recent research, deep learning–based instruction in mathematics has been shown to enhance students' HOTS abilities through the integration of real-life contexts and higher-order thinking activities, such as analysis, evaluation, and meaningful problem solving (Nugroho et al., 2025; Syafitri Azahra, Husna Farhana, Sani Aryanto, 2026). This reinforces that deep learning–based instruction not only contributes to conceptual understanding but also to the development of higher-order thinking skills through more meaningful learning experiences.

If examined further, the lesson planning has not yet been fully aligned with HOTS principles. The learning objectives, student worksheets, and assessment instruments still tend to emphasize correct answers and procedural steps, and therefore do not explicitly guide students toward analysis, evaluation, and reasoning. According to Manalo et al. (2019), meaningful learning occurs when students connect new knowledge with their experiences and real-world contexts, rather than merely completing algorithmic procedures. Nevertheless, the lesson planning also shows constructivist elements such as discussion, concept exploration, the use of concrete media, and reflective questioning.

This is in line with Manalo et al. (2019), who emphasized the importance of inquiry, dialogue, reflection, and collaboration in deep learning. Collaborative learning also supports the development of critical thinking because students are trained to articulate reasons and evaluate ideas (Loes & Pascarella, 2017). However, procedural worksheets, limited HOTS-oriented questions, and the lack of clear critical thinking indicators

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indicate that the learning process still places greater emphasis on final outcomes rather than thinking processes (Paul, 2006; Kuhn, 2019).

During the implementation of instruction, the deep learning approach begins to emerge through the use of everyday life contexts, concrete media such as number cards and place value boards, group discussions, and reflective questioning. Instruction is no longer entirely transmissive but instead begins to provide opportunities for students to actively explore concepts. The use of contexts such as money, house numbers, and vehicle license plates helps connect mathematical concepts to students' real-life experiences, while concrete media facilitates understanding of the abstract concept of place value (Halpern & Dunn, 2022; Lombardi et al., 2021). This indicates the presence of learning by understanding, although conceptual deepening still needs to be strengthened consistently.

However, classroom interactions still show teacher dominance. Although scaffolding and guiding questions have been used, students' thinking processes are still largely directed by the teacher, meaning that independent thinking has not yet developed optimally. According to Valeyeva et al. (2017), scaffolding should gradually lead students toward independent thinking. In practice, teachers often ask students to explain their reasoning, compare answers, and identify conceptual relationships, which in fact already points toward the development of critical thinking as suggested by (Dwyer et al., 2014).

In terms of assessment, although observation, questioning, group work, and reflection have been used, evaluation is still dominated by written exercises that focus on answer accuracy. This indicates that assessment has not yet fully captured students' thinking processes, such as strategies, reasoning, and problem-solving approaches. Facione (1990) emphasizes that critical thinking should be assessed through reasoning and reflection processes. In addition, the limited availability of HOTS-based instruments indicates a gap between active learning practices and an assessment system that remains procedural (Avargil et al., 2012). In line with this, research shows that the implementation of HOTS assessment in elementary schools still faces challenges in instrument development and consistency of application (Ningsi & Shaleh, 2024;Sudiryo et al., 2024).

The condition of assessment that is still outcome-oriented contributes to an answer-oriented learning culture among students. Students tend to focus more on obtaining the correct answer rather than on thinking processes or the exploration of strategies. Kuhn (2019) emphasizes that critical thinking develops through argumentation, justification, and reflection, rather than merely obtaining the correct answer. Thus, this orientation becomes one of the main barriers to the development of HOTS.

Overall, the implementation of deep learning in mathematics learning cannot rely solely on active activities such as discussions or the use of concrete media; it requires alignment among planning, implementation, interaction, and HOTS-oriented assessment. This study shows that the implementation is still at an emerging stage, as there is still a lack of synchronization in HOTS-based lesson planning, teacher-dominated interactions, procedural assessment practices, and an answer-oriented learning culture. These findings are consistent with the study by Dewi, Salzabilla and Amelia (2025) which emphasizes that the integration of deep learning and HOTS still requires strengthening, particularly in assessment practices and the consistency of instructional implementation.

3.3. Implications

The implications of these findings indicate that deep learning–based instruction on place value concepts needs to strengthen the alignment between learning objectives, learning activities, and assessment in order to be truly oriented toward Higher-Order Thinking Skills (HOTS). Teachers are not only expected to provide active and contextual learning experiences but also to ensure that instructional designs and assessments consistently foster students' abilities in analysis, reasoning, and reflection. Therefore, it is necessary to develop student worksheets and assessment instruments that evaluate thinking processes rather than merely final answers, as well as to apply scaffolding in a gradual manner to promote student independence. In addition, the culture of evaluation needs to shift from focusing on correct answers toward assessment that emphasizes argumentation and justification so that students' HOTS can develop more optimally.

3.4. Limitations

This study has several limitations. First, it was conducted in a single Grade V classroom at an elementary school with a limited number of participants. Therefore, the findings reflect a specific educational context and cannot be generalized to other schools or learning environments. The results should be interpreted within the scope of the study setting and participant characteristics. The qualitative descriptive design focused on exploring pedagogical practices rather than measuring instructional effectiveness; therefore, it does not quantify improvements in students' critical and creative thinking skills or establish causal relationships. Data were collected within a limited period, which may not fully capture long-term developments in students' higher-order thinking and teachers' instructional practices. Although triangulation and member checking were employed to enhance credibility, the findings remain influenced by researcher interpretation and participant

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perspectives. Furthermore, the study focused solely on place value instruction, limiting its applicability to other mathematics topics and subject areas. Future research should involve multiple schools and teachers, adopt longitudinal or mixed-method designs, and incorporate quantitative measures of higher-order thinking skills to provide broader and more comprehensive evidence of deep learning implementation.

4. Conclusion

This study aims to examine the implementation of deep learning-oriented instruction in teaching place value in elementary school. The findings reveal that the principles of deep learning can be integrated into mathematics learning through contextual learning, concept exploration, collaborative interaction, reflective questioning, and the use of concrete learning media, thereby creating meaningful learning experiences that support the development of students' critical and creative thinking skills. However, several challenges were identified, including the dominance of procedural teaching, assessment practices that still focus on final answers, limited instructional time, and students' habitual learning patterns. These conditions indicate the need to strengthen the alignment between learning objectives, instructional activities, and assessment practices that emphasize higher-order thinking skills (HOTS). The findings highlight the importance of designing learning environments that encourage reasoning, reflection, and active knowledge construction as an essential component of high-quality mathematics education. Therefore, future research is recommended to investigate the implementation of deep learning across different educational contexts and subject areas, as well as to examine its impact on the development of students' higher-order thinking skills through longitudinal and mixed-methods approaches.

Author Contributions

Juriana: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Validation, Visualization, Writing-Original Draft, Writing-Review & Editing; Agung Hartoyo: Conceptualization, Methodology, Supervision, Validation, Writing-Review & Editing; Asriah Nurdini Mardiyyaningsih: Conceptualization, Methodology, Supervision, Validation, Writing-Review & Editing. All authors contributed equally to the scientific content of this study, participated in the development and refinement of the manuscript, and have read and approved the final version of the manuscript.

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The author declares that there are no financial or non-financial conflicts of interest that could influence the execution, authorship, or publication of this article. Furthermore, the author has no personal, professional, or institutional relationships that could potentially bias the findings of this study.

Data Availability

The datasets generated during and/ or analyzed during the current study are available from the corresponding author on reasonable request.

Declaration on AI Use

AI was strictly limited to improving readability and language editing under the full supervision of the author. The entire scientific content, analysis, interpretation, and conclusions remain the sole responsibility of the author.

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