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Enhancing Learning through Deep Learning: Does It Foster Elementary Students' Conceptual Understanding and Motivation in Mathematics?

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Abstract

Deep learning is an instructional approach with valuable potential for Indonesian education and has increasingly been integrated into classroom practices. However, empirical evidence regarding its effectiveness in fostering elementary students' conceptual understanding and motivation in learning mathematics remains underexplored. This study utilized a quantitative quasi-experimental design to investigate the short-term effects of integrating a deep learning approach on their conceptual understanding and learning motivation in mathematics, especially in fraction topics. The participants were 60 third graders from two public elementary schools in Sepaku, East Kalimantan, Indonesia. This study employed convenience sampling strategy with one class selected as an experimental group and another assigned to a control group. Data were collected through a conceptual understanding test and a learning motivation questionnaire. The results revealed statistically significant differences between the two groups. The findings conclude that the implementation of deep learning approach contributes to students' conceptual understanding and motivation in learning mathematics.

Keywords: *deep learning approach; mathematical conceptual understanding; learning motivation; elementary school, fraction topics.*

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INTRODUCTION

Elementary education plays a fundamental role in building students' cognitive foundations, particularly in mastering mathematical concepts that serve as the basis for learning at higher educational levels (Gavin, 2024). Enhancing students' conceptual understanding in learning mathematics is a key objective in elementary education, as it enhances students to improve logical, systematic, critical, and analytical thinking skills (Yuliandari & Anggraini, 2021). Therefore, mathematics instruction in elementary schools should not only emphasize procedural mastery or algorithmic problem solving but also focus on constructing their conceptual understanding. Since, conceptual understanding employes students to comprehend the meaning of mathematical concepts comprehensively, relate them to other concepts, and apply them in various real-life situations (De Zeeuw et al., 2013). However, based on observation result, mathematics instruction in elementary schools in east Kalimantan, Indonesia is still frequently oriented toward memorizing formulas and procedural learning, which limits students' opportunities to construct meaningful conceptual understanding (Aisyah et al., 2024; Aryanto et al., 2024; Prasasti et al., 2020). Moreover, this fragmented approach may also lead to low student motivation in learning mathematics. Students with low learning motivation tend to show minimal participation in the learning process (Bojović & Antonijević, 2017). As a result, learning activities become passive, thereby limiting students' opportunities to develop their conceptual understanding. Such conditions indicate that mathematics instruction requires innovative instructional approaches that can enhance both students' conceptual understanding and their learning motivation (Braithwaite & Siegler, 2021; Wilkins & Norton, 2018).

The implementation of the *Pembelajaran Mendalam* approach, commonly referred to in Indonesia as deep learning in mathematics instruction, has effectively contributed to elementary students' conceptual understanding as well as their motivation to learn mathematics (Barokah & Mahmudah, 2025; Iriawan et al., 2025). The urgency of implementing learning approaches oriented toward deep learning is also aligned with the direction of Indonesian Ministry of Primary and Secondary Education through the integration of the Merdeka Curriculum. This approach emphasizes student-centered learning, the strengthening of conceptual understanding, and students' active engagement in constructing knowledge meaningfully (Wiryanto et al., 2025). Through this approach, students are encouraged to connect new knowledge with their prior knowledge or experiences, making the learned concepts more meaningful and easier to apply across various learning contexts. Other studies have also shown that students who learn through this approach has better problem-solving skills and deeper conceptual understanding (Hidayat & Haryati, 2025). Therefore, the implementation of the deep learning approach in elementary mathematics learning has the potential to create more meaningful learning experiences while improving students' conceptual understanding and learning motivation.

The deep learning approach is relevant to be implemented in elementary schools to foster students' conceptual understanding and motivation in learning mathematics. This approach emphasizes three key characteristics of learning, namely mindful, meaningful, and joyful learning (Widyastuti et al., 2025). Mindful learning promotes students' conscious and reflective engagement in the learning process, meaningful learning helps students connect new knowledge with their prior knowledge or experiences, while joyful learning creates an enjoyable and motivating learning environment. Through the integration of these three characteristics, the deep learning approach can enhance students' active engagement as well as strengthen their conceptual understanding and problem-solving skills in mathematics learning (Wiryanto et al., 2025). These components are particularly important for elementary students, as they are in a crucial developmental stage where they begin transitioning from concrete to abstract thinking, making it essential to address the gap between abstract mathematical concepts and their level of understanding (Siregar et al., 2025). Furthermore, the emphasis on joyful learning also has a critical affect in improving students' learning motivation (Hamidah et al., 2025). On the other hand, teachers are expected to implement the deep learning approach as part of their responsibility and efforts to enhance the quality of learning to response the demands of the Merdeka Curriculum (Mahardika & Jaya, 2025). As a result, this approach has increasingly been integrated into classroom practices.

Although the advantages of the deep learning approach have been widely reported, it examines in enhancing conceptual understanding and learning motivation in the context of mathematics education, particularly at the elementary level, remains relatively underexplored in a comprehensive manner. Previous studies have generally highlighted the effectiveness of deep learning in improving problem-solving skills and conceptual understanding (Maharani et al., 2025; Mahardika & Jaya, 2025; G. Wibowo et al., 2025).

In the context of mathematics education, fractions are one of the topics that often pose difficulties for elementary school students. The concept of fractions is inherently abstract, as it involves understanding relationships between parts and wholes as well as symbolic representations (Norairi et al., 2022; Tadeu, 2024). As a result, many students experience misconceptions, such as difficulties in comparing fraction values, understanding part–whole relationships, and connecting visual, symbolic, and contextual representations. These difficulties often arise because instruction tends to emphasize computational procedures rather than conceptual understanding. In contrast, various studies have shown that mathematics learning emphasizes conceptual exploration and active student engagement can enhance learning motivation while strengthening students' mathematical understanding (Barokah & Mahmudah, 2025; Cahyaningsih et al., 2025). Therefore, fractions can serve as a relevant context for examining and analyzing students' conceptual understanding in mathematics.

In addition, research by Netriwati et al. (2025) found that the implementation of the deep learning approach in elementary mathematics learning can enhance students' conceptual understanding through reflective learning processes, active engagement, and meaningful concept connections. Nevertheless, the study was limited to arithmetic operations and did not specifically examine fraction learning, which involves higher levels of conceptual abstraction for elementary students. Also, the study did not integrate learning motivation as an important variable in the mathematics learning process. In fact, several studies have examined the improvement of students' motivation in learning mathematics after this approach was implemented in elementary schools (Barokah & Mahmudah, 2025; Hamidah et al., 2025). In line with this, there remains a research gap in examining the implementation of the deep learning approach that together influences elementary school students' conceptual understanding and their learning motivation on the topic of fractions, as these aspects in classroom practices have not yet been empirically explored.

Based on these considerations, this study is deemed important to assist teachers in designing mathematics instruction that supports students' conceptual understanding and motivation to learn, particularly on the topic of fractions. One notable aspect of this study is its focus on empirical examining how teachers implement the deep learning approach in classroom practice by integrating the principles of mindfulness, meaningful, and joyful learning. In addition, the investigation of students' motivation during the learning process makes this study distinctive, as it provides insights into how instructional approaches influence students' engagement in mathematics learning. This study is expected to contribute to the development of more meaningful mathematics learning practices and provide empirical evidence for teachers in designing instructional strategies that foster deeper conceptual understanding and stronger learning motivation among elementary school students. Furthermore, two research questions (RQs) were proposed in this study concerning elementary students' conceptual understanding of fractions as enhanced by the deep learning approach (RQ1) and elementary students' learning motivation in mathematics as by the deep learning approach (RQ2).

METHODS

The main objective of this study was to investigate the short-term effects of how integrating a deep learning approach could foster elementary students' conceptual understanding and motivation in learning mathematics. In line with this, the study followed a quantitative quasi-experimental using post-test-only control group design with a single-blind procedure, in which outcomes were measured only after intervention. This procedure was utilized to simulate an actual classroom environment, ensuring that participants remained unaware of pedagogical conditions to which they were assigned (Cohen et al., 2017). To address the research objectives, two treatment conditions were established using experimental group and control group (Cresswell, 2018). The experimental class was designed to represent the implementation of a deep learning approach in an actual classroom environment. On the other hand, the control group was assigned to follow the teachers' lesson plan, which employed a direct instruction method with demonstrations as conventional teaching practices.

Research Participants

The participants were 60 third-grade students from two public elementary schools in Sepaku, Penajam Paser Utara Regency, East Kalimantan, Indonesia. The sample was selected using convenience sampling, in which participants were selected based on criteria relevant to the research objectives, as well as their availability and accessibility to the researchers (Cohen et al., 2017). Furthermore, both schools were divided so that one class from one school was chosen as the experimental group ($n = 30$), while another class served as control group ($n = 30$). We ensured that both schools had comparable conditions, following: (a) previous mathematics course grades; (b) prior mathematics learning experiences; and (c) instruction on fraction topics; to minimize potential biases in student characteristics for research subjects.

Intervention Settings

The short-term intervention was conducted in three teaching sessions for the 2025/2026 academic year, designed for elementary mathematics learning on fraction topics in accordance with the Merdeka Belajar Curriculum on Phase B. Each session of the intervention lasted approximately 70 minutes. The intervention focused on introducing simple fractions (unit fractions with numerator 1) with small denominators such as 2, 3, 4, 6, and 8 (Abrika et al., 2023; Bruce et al., 2023; Tossavainen & Helenius, 2024). This study considered the teachers' lesson plan or *modul ajar* as a benchmark for lesson implementation. Focus group discussion with the school principal and teachers was conducted to ensure that the implementation of the learning process followed the planned lesson design and reflected the instructional practices commonly implemented in the public elementary schools. The implementation of focus group discussions in this research is shown in Figure 1. In this research, the teaching practices examined were designed to simulate the implementation of a deep learning approach under natural classroom conditions, as represented by the experimental class. The control group followed the teachers' lesson plan by adopting direct instruction method with demonstrations as conventional teaching practices.

Figure 1. Focus group discussion with the school principal and teachers

Data Collection and Instruments

Data were collected through two main instruments after the intervention (post-tests). The first instrument was a conceptual understanding test, constructed based on indicators of basic mathematical understanding in solving fraction problems. The test was adapted in accordance with the learning performance outlined for Phase B in the third-grade mathematics syllabus in Indonesia. The conceptual understanding indicators were adapted from Efendi et al. (2022), Fuchs et al. (2013), and Hecht et al. (2003) across several key dimensions to evaluate the extent to which students can recognize fractions as parts of a whole (*part–whole*) and are able to represent and measure these parts (*measurement interpretation*). Hence, the conceptual understanding test items were reconstructed based on the elementary school mathematics syllabus and indicators of conceptual understanding. The items were designed to reflect four main dimensions: understanding fraction concepts, fraction representation, comparing fractions, and applying fractions in real-life contexts.

The second instrument was a mathematics learning motivation questionnaire, administered after the completion of the written test. The questionnaire used four-point Likert scale ranging from 1 (Disagree) to 4 (Strongly Agree) and was adapted from (Orosco, 2016), following the guidelines outlined in *"Measuring Elementary Students' Mathematics Motivation"* to collect quantitative data on elementary students' motivation in learning mathematics. The motivation questionnaire consisted of 15 statement items developed based on several key indicators of learning motivation. These indicators included students' interest in learning mathematics, others assessed active engagement in learning, and the remaining items measured the perceived value or importance of learning mathematics, students' effort in dealing with difficulties when solving mathematical problems, and self-regulated learning.

Data Analysis

The data of this study were analyzed using descriptive and inferential statistical methods in SPSS 24. The data obtained from the conceptual understanding test and the learning motivation questionnaire were first examined to ensure that the classical assumptions were met before conducting further analysis. The assumptions tested included the normal distribution of the dependent variable in both groups, and the homogeneity of variance of the dependent variable in both groups (Knapp, 2020). After these assumptions were satisfied, an independent samples t-test was conducted to examine the effectiveness of the treatment applied to the experimental and control groups and to determine differences in students' conceptual understanding and learning motivation between the two groups. To address this, the study tested the following null hypotheses:

$\boldsymbol{H_{01}}$: There is no statistically significant difference in elementary students' conceptual understanding of fraction concepts between the experimental and control groups.

$\boldsymbol{H_{02}}$: There is no statistically significant difference in elementary students' motivation in learning mathematics between the experimental and control groups.

RESULTS AND DISCUSSION

Descriptive Statistics Results from Experimental and Control Groups

Descriptive statistics for the main variables are presented in Table 1. The results show that students in the experimental group achieved higher mean scores in both conceptual understanding and learning motivation compared to those in the control group. Regarding these results, the mean score for conceptual understanding in the experimental group was 85.10 (SD = 3.30), while the control group obtained a mean score of 69.50 (SD = 2.61). Similarly, for learning motivation, students in the experimental group

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obtained a mean score of 82.27 (SD = 3.27), while the control group obtained a mean score of 67.50 (SD = 2.61).

Table 1. Descriptive statistics for the main variables

Variables	Groups	N	Mean	Std. Deviation	Actual Range
Conceptual understanding	Experimental	30	85.10	3.30	79 – 92
	Control	30	69.50	2.61	65 – 74
Learning motivation	Experimental	30	82.27	3.27	76 – 88
	Control	30	67.50	2.61	63 – 72

Results of Assumption Tests

Assumption testing was performed to examine whether there was a statistically significant difference between the mean scores of the two groups. Therefore, the selection of the statistical test was based on meeting the assumptions required for the t-test for the two previous variable data. Hence, the data from both variables were examined to ensure that the key assumptions were fulfilled, such as normality of distribution and homogeneity of variance.

First, we analyzed the data from both variables using the Shapiro–Wilk normality test to test whether the data were from a normally distributed population. The results test indicated that all significance values for the data from these two variables, in both the experimental and control groups, were greater than 0.05. It can be concluded that the data for both variables met the assumption of normality. Second, data from each variable were analyzed to homogeneity determine whether the data were consistent or had equal variances between the two groups. Based on these results, homogeneity of variance was confirmed through Levene's test, with significant values of 0.298 for conceptual understanding and 0.269 for learning motivation. As the significant value was higher than 0.05, it can be concluded that the assumption of homogeneity was fulfilled. The output of the normality and homogeneity test is respectively presented in Table 2.

Table 2. Output of the normality and homogeneity test

Variables	Groups	Normality			Homogeneity	
		Statistic	df	Sig.	F	Sig.
Conceptual understanding	Experimental	0.971	30	0.521	1.103	0.298
	Control	0.963	30	0.407		
Learning motivation	Experimental	0.965	30	0.432	1.247	0.269
	Control	0.958	30	0.318		

Group Comparison Results of Conceptual Understanding

In this section, it was examined whether there was a statistically significant difference between the mean scores of students in two groups through their mathematical conceptual understanding. The results revealed a statistical difference between the experimental group ($M = 85.10$; $SD = 3.30$) and the control group ($M = 69.50$; $SD = 2.61$). The distribution of elemantary students' conceptual understanding scores on the topic of fractions in both groups is presented in Figure 2. This difference was followed by a *t*-value of 19.240 with 58 degrees of freedom (*df*) and a significant value of 0.000, as illustrated in Table 3. Moreover, the mean difference of 15.602 indicates a substantial gap in average conceptual understanding between the two groups, accompanied by a relatively small standard error difference of 0.792. Given that the significance value was below 0.05, the null hypothesis related to conceptual understanding (H_{01}) was rejected. These findings show that there is a statistically significant difference between the two groups in students' conceptual understanding. Hence, it can be concluded that the intervention in the experimental group contributed positively to students' conceptual understanding compared to the control group.

Table 3. Independent Sample T-test Results for Students' Conceptual Understanding

Variables	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Conceptual understanding	19.240	58	0.000	15.602	0.792

Group Comparison Results of Learning Motivation

To address the second research question of this study, a statistical analysis was conducted to examine whether there was a significant difference between the mean scores of students in the experimental and control groups in terms of their learning motivation. The analysis revealed a statistically significant difference in students' learning motivation between the experimental and control groups ($t(58) = 19.227, p = 0.000$), as shown in Table 4. The mean difference of 14.766 indicates a substantial gap between the two groups, with a relatively small standard error difference of 0.758. Since the $p - value$ was below 0.05 ($p = 0.000$), also the null hypothesis related to learning motivation (H_{02}) was rejected. Therefore, the findings indicate that the intervention in the experimental group contributed positively to students' learning motivation compared to the control group.

Table 4. Independent Sample T-test Results for Students' Learning Motivation

Variables	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Learning motivation	19.227	58	0.000	14.766	0.758

Actual Performance of Difference Between the Groups

Based on the significance values from the independent samples t-test, there was a statistically significant difference in actual performance of difference between the groups. The scores for conceptual understanding ($MD = 15.602$; $p = 0.000$) and learning motivation ($MD = 14.776$; $p = 0.000$) were higher in the group that received the intervention using the deep learning approach compared to the group that followed conventional instruction. These results show that the experimental group performed higher than the control group. These findings confirm that the implementation of the deep learning approach positively contributes to the enhancement of elementary students' conceptual understanding and motivation in learning mathematics, especially in basic fraction topics. Figure 2 illustrates the comparison of the average scores for each group.

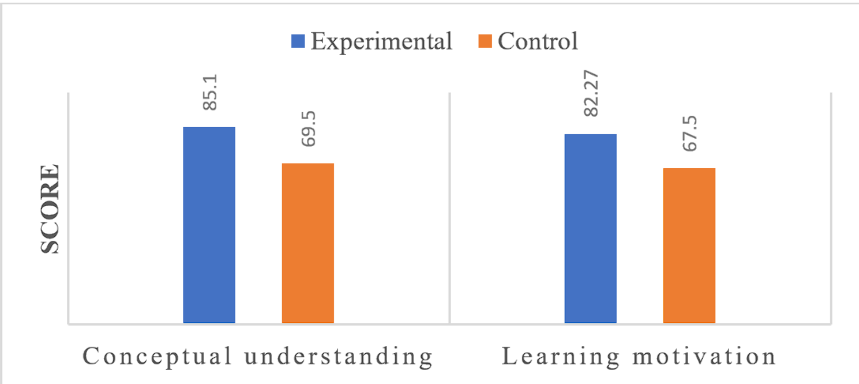

Figure 2. Comparison of the Average Scores for Each Group

Discussion

The main objective of this study was to examine how the integrated implementation of the deep learning approach enhances third-grade students' conceptual understanding and motivation in mathematics, particularly on the topic of fractions. Based on this objective, two research questions (RQs) were formulated to guide the discussion. This section further explores the extent to which our findings align with previous research.

RQ1: Could elementary students' conceptual understanding of fractions be enhanced by the deep learning approach?

The results of this study indicate that the implementation of the deep learning approach has a positive effect on elementary students' conceptual understanding of mathematics. Students who participated in deep learning-based instruction demonstrated better conceptual understanding compared to those who received conventional instruction. This suggests that the deep learning approach is effective in supporting elementary students foster their mathematical conceptual understanding.

The learning activities in the experimental group were based on *modul ajar* designed according to the principles of the deep learning approach, which emphasize joyful, mindful, and meaningful learning experiences. The joyful aspect was reflected in a pleasant and interactive learning environment, where students were actively engaged in various collaborative activities, such as group discussions and concept exploration. The mindful aspect was evident in students' involvement in conscious and reflective thinking processes, as they were encouraged to develop a deeper understanding of concepts by posing questions and evaluating their own understanding through reflective activities facilitated by the teacher. Meanwhile, the meaningful aspect was realized by connecting the learning materials to real-life contexts, enabling students to recognize the relevance of the mathematical concepts they learned. Through these three characteristics, students were not merely passive recipients of information but actively constructed their own knowledge. This approach is consistent with constructivist theory, which posits that knowledge is actively constructed by learners through meaningful learning experiences (Olusegun, 2015). The improvement in conceptual understanding can be explained by the pedagogical mechanisms inherent in deep learning approach, where instruction no longer focuses on mechanical procedural mastery but instead emphasizes cognitive elaboration processes that support students in constructing meaning from the concepts being learned (Fitriani, 2025).

The findings of this study are consistent with previous research emphasizing the effectiveness of the deep learning approach in enhancing students' conceptual understanding in mathematics. Hamidah et al. (2025) and Wibowo et al. (Wibowo et al., 2025) reported that the implementation of deep learning significantly improves students' mathematical reasoning and conceptual understanding. Similar findings were also reported by Rina et al. (2025), who highlighted the importance integrating deep learning approach in learning mathematics to support elemantary students in constructing more robust conceptual understanding. Numerous studies suggest that when students are actively engaged in the learning process and provided opportunities to explore and reflect on mathematical ideas, they are more likely to develop deeper conceptual understanding (Mahardika & Jaya, 2025; Mailani, 2025). In this context, the deep learning approach is considered capable of fostering a learning environment that promotes cognitive engagement and the meaningful construction of knowledge. On the other hand, students in the control group, who experienced conventional instruction, tended to focus on procedures and formulas without fully understanding the underlying mathematical concepts. This condition made it difficult for them to solve novel problems requiring reasoning or conceptual generalization. This finding reinforces the view that meaningful mathematics

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instruction should encourage students to actively construct knowledge rather than merely receive information from the teacher.

Although this study shows that the deep learning approach can help promote students' conceptual understanding of mathematics, other empirical support for its effectiveness in mathematics education remains underexplored. This is reflected in several studies indicating that other factors, such as the instructional models employed (Bariroh, 2025; Netriwati et al., 2025), and teachers' roles (Jumelan et al., 2025), also influence students' learning performance. This suggests that the deep learning approach has not yet been widely recognized as a primary pedagogical approach, but rather as a complementary one. In this context, its effect can be considered moderate and has not been extensively reported in the literature. Moreover, while students who received mathematics instruction through the deep learning approach achieved higher average scores on conceptual understanding tests compared to those who did not, this improvement may be attributed to higher levels of engagement, as reported by Mailani et al. (2025). Consequently, other mediating variables may also have contributed, such as differences in teacher performance across groups and variations in students' prior learning motivation between the two groups.

RQ2: Could elementary students' learning motivation in mathematics be enhanced by the deep learning approach?

The second objective of this study was to investigate the effect of the deep learning approach on elementary students' motivation to learn mathematics through the concept of fractions. This objective aimed to examine the accompanying effects on the affective domain. The results showed a statistically significant difference between the experimental and control groups, as expected, with the group receiving the deep learning intervention demonstrating higher levels of learning motivation. These findings indicate that the deep learning approach is also effective in supporting elementary students to foster their motivation to learn mathematics.

This study is consistent with previous research indicating that students' learning motivation increases following the integration of the deep learning approach in instruction into classroom practices (Bambang et al., 2025; Barokah & Mahmudah, 2025; Mailani et al., 2025). One important factor that drives motivation is the opportunity given to students to actively engage in the learning process. Such engagement strengthens their sense of ownership over the knowledge they acquire, which in turn fosters self-confidence and a desire to continue learning. A collaborative and supportive classroom atmosphere also creates an enjoyable learning environment, allowing students to learn mathematics without feeling anxious or pressured. Furthermore, the deep learning approach provides opportunities for students to achieve meaningful success, not merely in terms of scores or final grades. Formative feedback from teachers throughout the learning process helps students understand their strengths and weaknesses, while encouraging self-improvement without fear of failure (Jumelan et al., 2025). Even small achievements, such as successfully solving challenging problems with peers, can serve as powerful motivators for students to persist in learning and to embrace new challenges.

Engelina et al. (2025) also support these findings by emphasizing that the use of manipulative learning media can help stimulate students' motivation in learning mathematics within a deep learning context. In line with this, Dalia et al. (2025) and Netriwati et al. (2025) also states that the implementation of contextual learning models makes the learning process more authentic, engaging, and relevant to students' real-life experiences. Contrary to conventional teacher-centered approaches, the deep learning approach (emphasizes joyful and meaningful learning) creates learning experiences that foster both emotional and cognitive engagement, thereby encouraging students to actively construct their own understanding, engage in reflective thinking, and participate more deeply in the learning process.

Limitations

This study has several limitations that may affect the generalizability of the findings, particularly the relatively small sample size and the focus limited to the topic of fractions. In addition, the sample was drawn from a public elementary school in the Sepaku area, which is relatively homogeneous, thereby limiting the diversity of participants. Therefore, we suggest that future research could involve adequate sample sizes with broader coverage, for instance by implementing the intervention across multiple classes or schools, as well as examining other mathematics topics at elementary school. Consequently, the effectiveness of the deep learning approach in enhancing students' conceptual understanding and learning motivation can be examined more comprehensively. Lastly, this study involved two different teachers from two schools to instruct the experimental group and the control group with the aim of minimizing bias. However, differences in teaching experience between the two teachers may have influenced the quality of instruction and thus should be acknowledged as a limitation when interpreting the findings.

CONCLUSION AND SUGGESTIONS

The findings of this study indicate differences associated with the implementation of the deep learning approach in elementary school mathematics instruction. There is evidence that this approach positively contributes to students' conceptual understanding and learning motivation. Learning activities that integrate the deep learning approach led to a stronger understanding of fraction concepts and higher levels of learning motivation compared to students who experienced conventional instruction. Descriptive statistical analysis revealed that the experimental group achieved higher mean scores in both conceptual understanding and learning motivation than the control group. Furthermore, inferential analysis confirmed that these differences were statistically significant. Thus, it can be concluded that the experimental group statistically significantly outperformed the control group in terms of both conceptual understanding test scores and motivation to learn mathematics. These findings suggest that instructional practices that emphasize mindful, meaningful, and joyful learning environment enable students to construct mathematical knowledge more deeply while together enhancing their motivation to learn. Overall, this study provides evidence that the implementation of the deep learning approach can foster elementary students' conceptual understanding and motivation in learning mathematics.

Based on the limitations of this study, our research suggests involving a larger sample size and a broader scope by implementing the intervention across multiple classrooms or schools. In addition, further studies should explore the effectiveness of the deep learning approach in enhancing students' conceptual understanding and learning motivation across various mathematics topics or other fraction topics at the elementary school level. Expanding the scope of investigation to include the examination of other competencies that align with the integration of this approach is also recommended. Nevertheless, the results of this study show that the integration of the deep learning approach should be implemented more frequently in classrooms or schools that have the potential to conduct mathematics instruction, as it has been shown to positively contribute to students' conceptual understanding and motivation in learning mathematics.

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