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APPLICATION OF FRACTION BLOCK MEDIA BASED ON DEEP LEARNING TO IMPROVE STUDENTS' UNDERSTANDING OF FRACTION

Budi Halomoan Siregar*[1], Adi Sinaga[2], Juanda Rifki Simanjuntak[3], Qamaruddin Fadhilah Harahap[4], Rani Nuldiva Situmorang[5]
Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Negeri Medan[1,2,3,4,5]
email : budihalomoan@unimed.ac.id

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ABSTRACT

This study aims to determine the effectiveness of applying fraction blocks based on a deep learning approach in improving students' understanding of fraction material in the seventh grade of MTs. The type of research used is an experiment with a One Group Pretest-Posttest design. The research subjects were 24 seventh-grade students at MTs Cerdas Murni. Data were obtained through pretest and posttest tests and observation of student learning activities, then analyzed descriptively and inferentially using the t-test. The results show that the average pretest score of students was 63.33, which increased to 72.5 on the posttest, and the t-test results show a significant difference between the two scores (t_{value} = 3.406 > t_{table} = 2.069). These findings prove that the use of fraction block media based on the deep learning approach is effective in helping students understand the conversion of common fractions to mixed fractions and vice versa. In addition, this media is also able to increase student learning activity through more concrete manipulative and visual activities.

Keywords: *learning media; fraction blocks; concept understanding; fractions; deep learning*

ABSTRAK

Penelitian ini bertujuan untuk menentukan efektivitas penerapan blok pecahan berdasarkan pendekatan pembelajaran mendalam dalam meningkatkan pemahaman siswa tentang materi pecahan pada kelas VII MTs. Jenis penelitian yang digunakan adalah eksperimen dengan desain One Group Pretest-Posttest. Subjek penelitian adalah 24 siswa kelas VII di MTs Cerdas Murni. Data diperoleh melalui tes pretest dan posttest serta pengamatan aktivitas belajar siswa, kemudian dianalisis secara deskriptif dan inferensial menggunakan uji-t. Hasil menunjukkan bahwa rata-rata skor pretest siswa adalah 63,33, yang meningkat menjadi 72,5 pada posttest, dan hasil uji t menunjukkan perbedaan yang signifikan antara kedua skor tersebut (t_{hitung} = 3,406 > t_{tabel} = 2,069). Temuan ini membuktikan bahwa penggunaan media blok pecahan berdasarkan pendekatan pembelajaran mendalam efektif dalam membantu siswa memahami konversi pecahan biasa menjadi pecahan campuran dan sebaliknya. Selain itu, media ini juga mampu meningkatkan aktivitas belajar siswa melalui aktivitas manipulatif dan visual yang lebih konkret.

Kata kunci: *media pembelajaran; blok pecahan; pemahaman konsep; pecahan; pembelajaran mendalam*

INTRODUCTION

Mathematics serves as a vital pillar for developing analytical and systematic reasoning skills. Within this field, fractions occupy a fundamental position, acting as a mandatory prerequisite for grasping advanced topics like algebra, percentages, and ratios. Ideally, students

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should master these concepts early to ensure success in their subsequent academic journeys. However, the inherently abstract nature of fractional values often poses a significant cognitive barrier, particularly for individuals transitioning from the concrete to the formal operational stage. Mastery in this area is not merely about arithmetic but about building a structural understanding of how numbers relate to one another as parts of a whole. A solid grasp of fractions is essential for navigating the elementary and middle school curriculum effectively. Without this conceptual foundation, learners often find themselves struggling with more complex mathematical landscapes at higher educational levels (Arifin et al., 2023; Ayieko et al., 2022; Bruce et al., 2023). Therefore, ensuring that students can internalize ini principles through meaningful engagement is paramount for fostering long-term mathematical literacy and overall academic confidence in a rapidly evolving and highly dynamic global and modern contemporary world (Maralova, 2024; Tractenberg et al., 2024).

In reality, many students encounter persistent hurdles when attempting to decipher the complexities of fractional concepts. These challenges extend beyond basic calculations to include deep-seated conceptual gaps, such as the inability to distinguish between common fractions and mixed fractions or to comprehend fractions as representative parts of a unified whole. A major contributing factor is the current educational tendency to overemphasize mechanical procedures and rote memorization rather than nurturing a profound conceptual awareness. Consequently, learners often struggle to apply ini numbers to real-life situations or to manage fractions with differing denominators accurately (Kartal & Demirci, 2025; Lenz et al., 2024; Siegler et al., 2020). At the middle school level, specifically within certain seventh-grade cohorts, there is a noticeable reliance on memorized steps for converting fractional types without any underlying grasp of the mathematical logic involved. This gap between the desired conceptual mastery and the actual procedural dependency highlights a critical flaw in traditional instructional methods. When students fail to see the logic behind the numbers, they become disconnected from the subject, leading to a fragmented understanding that effectively hinders their cognitive growth (Adeleke et al., 2025; Putri et al., 2025).

The difficulties experienced by students have a far-reaching impact that transcends low academic scores, deeply affecting their psychological attitude toward the entire subject. Mathematics is frequently perceived as an arduous, uninspiring, and memory-heavy discipline, which can extinguish any natural curiosity. Such negative perceptions often trigger a decline in learning motivation and may even lead to the development of math anxiety. This emotional distress creates a detrimental cycle where the higher the anxiety, the lower the actual learning outcomes, effectively stifling a student's cognitive potential. A lack of meaningful practice further compounds this issue, leaving learners unaware of why conceptual understanding is vital for their intellectual growth. Instead of viewing the subject as a tool for problem-solving, they see it as a series of obstacles to be avoided. Addressing this malaise requires a shift in how mathematical material is presented and evaluated. Without an intervention that prioritizes emotional engagement and cognitive clarity, students remain trapped in a state of academic frustration, unable to appreciate the elegance and utility of mathematical reasoning (Bouchard & Matthews, 2025; Castillo et al., 2025; Ojo et al., 2023; Schoenherr et al., 2025).

To bridge the gap between abstract theory and concrete reality, innovative learning tools such as fraction blocks are increasingly necessary. This manipulative media allows students to engage directly with physical representations, transforming intangible ideas into tangible objects that can be moved and rearranged. Fraction blocks, typically crafted from colorful paper or solid materials in various sizes, represent specific fractional values such as one-half or one-

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third. By physically comparing, aligning, and breaking down ini blocks, learners can visually observe the relationships between common and mixed fractions. This interactive experience significantly reduces the perceived difficulty of the material by providing an enjoyable and stimulating environment for exploration. Beyond merely simplifying the content, such tools increase student participation by making the learning process a hands-on adventure rather than a passive lecture (Flint et al., 2020; Kestin et al., 2025). The use of manipulative aids has been shown to improve academic results while simultaneously boosting the internal drive to learn. By providing a multisensory approach to mathematics, fraction blocks help demystify the subject, allowing students to construct their own understanding of fractional proportions.

This research introduces a novel integration by combining fraction block media with a *deep learning* approach. This pedagogical strategy emphasizes a conscious and meaningful process where students are fully involved in understanding and applying knowledge rather than just repeating information. *Deep learning* seeks to transform traditional paradigms into constructive experiences that foster critical, creative, and adaptive thinking. When paired with manipulative tools, this approach encourages students to analyze visual representations and connect them to abstract symbols, making the thinking process truly reflective. This integration prioritizes exploration and reflection, allowing learners to build sustainable knowledge that remains relevant in various new situations. The current study specifically examines how this combined method can alleviate the conversion struggles faced by seventh-grade students at an Islamic middle school. By focusing on the transition between mixed and common fractions, the research aims to establish a more effective instructional framework. Ultimately, this innovation provides a pathway for preparing generations capable of lifelong learning, ensuring they can navigate the uncertainties of a dynamic global landscape with confidence.

RESEARCH METHODS

This study uses a quantitative approach with an experimental research design. The design used is a One Group Pretest-Posttest Design, which involves administering a pretest before the learning process and a posttest after the learning process is complete. This design was chosen because it can be used to see how effective the use of Fraction Blocks based on deep learning approach is in improving students' understanding of fractions in grade VII MTS. In this design, there are two measurements, namely before and after learning, so that changes in student learning outcomes can be observed directly.

This research was conducted at Madrasah Tsanawiyah (MTS) Cerdas Murni, located at Jalan Beringin No. 33, Tembung, Percut Sei Tuan District, Deli Serdang Regency. The research subjects were 24 students in class VII B. The research process was carried out in several stages. The first stage was to prepare the learning tools, the Fraction Blocks media, and the concept comprehension test instruments. The second stage was administering a pretest to determine the students' initial ability to understand fractions. The third stage was teaching using the Fraction Blocks media based on deep learning approach. In this stage, the teacher guided the students to explore through manipulation-based activities, such as arranging and comparing fraction blocks, so that the students could understand the relationship between common fractions, mixed fractions, and the conversion process visually. After the learning process, students are given a posttest to see the improvement in their understanding after using the media. The research instrument is a written test in the form of short essay questions. Data collection techniques are carried out through the results of the pretest and posttest and are supported by observations of student activities during the learning process. Data analysis is carried out using two methods,

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namely descriptive and inferential analysis. Descriptive analysis was used to describe the distribution of scores, averages, and percentages of student learning outcomes. Meanwhile, inferential analysis was conducted using a paired sample t-test to determine whether there was a significant difference between the pretest and posttest results.

RESULT AND DISCUSSION

Result

Based on the results of research conducted by researchers at Madrasah Tsanawiyah (MTs) Cerdas Murni, data was collected through test instruments to determine the mathematics learning outcomes of seventh-grade MTs students in the skill of converting common fractions to mixed fractions and vice versa. Analysis of the pre-test data on mathematics learning outcomes in the skill of converting common fractions to mixed fractions and mixed fractions to common fractions for seventh grade students, with a total of 24 students, showed that there were 8 students who obtained the maximum score, but most of the rest were in the very low category. From the recapitulation of the scores of seventh-grade MTs students in converting common fractions to mixed fractions and vice versa before the treatment (pre-test), the data can be seen based on the frequency and percentage levels as follows:

Table 1. Student Grade Categories

Categorization	Frequency	Percentage
Very High	8	33,33 %
High	3	12,50 %
Medium	0	0,00 %
Low	3	12,50 %
Very Low	10	41,67 %
Total	24	100 %

Based on the data shown in the table 1 above, it can be concluded that the students' learning outcomes in the pre-test stage using the test instrument were mostly in the Very Low (41.67%), Low (12.50%), High (12.50%), and Very High (33.33%) categories, while there were no students in the Medium category. Looking at the existing percentage results, it can be said that the level of students' ability to convert common fractions into mixed fractions and vice versa before treatment was low. Based on the pre-test descriptive analysis results table, to find the mean (average) pre-test score of students in class VII MTS Cerdas Murni. The average learning outcome of grade VII MTs before the treatment was given was 63.33, which was considered low.

After conducting the pretest before using the fraction block media, the next treatment was given by applying the fraction block media in the learning process. During the research period, the experimental class showed changes after the treatment was given. These changes were seen in the improvement in students' learning outcomes regarding fractions, which can be seen from the posttest scores obtained after the treatment was applied. From the calculation of students' post-test scores in answering questions about converting mixed fractions to common fractions and common fractions to mixed fractions, they can be categorized based on frequency and percentage as follows:

Table 2. Student Grade Categories

Categorization	Frequency	Percentage
Very High	7	29,17 %
High	6	25.00 %

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Medium	4	16,67 %
Low	3	12,50 %
Very Low	4	16,67 %
Total	24	100 %

Based on the data in the table 2 above, it can be stated that the learning outcomes of students after the treatment, namely the application of the "Fraction Block Media" learning media, were categorized as very high at 29.17%, high at 25.00%, moderate at 16.67%, low at 12.50%, and very low at 16.67%. From these results, it can be concluded that the students' ability to answer questions about converting common fractions to mixed fractions and mixed fractions to common fractions after the application of learning media is relatively high.

Based on the table of the students' post-test scores, the scores were analyzed to find the mean (average) post-test score of the seventh-grade students at MTs Cerdas Murni. From the results of the average value table above, it can be seen that the value of $\sum FX = 1740$, while the number of students or the value of N is 24. From the above calculations, it was found that the mean value of student learning outcomes after the application of fraction learning media was 72.5% of the maximum score of 100.

The researcher set a mastery standard of (70) ≥ 70% to be achieved or exceeded. From the average score, it can be concluded that the students' ability to answer fraction questions after learning using the "Fraction Block Media based on deep learning approach" in class VII MTS Cerdas Murni has met the classical learning outcome standard, where 72.5% ≥ 70% of students have met the mastery standard.

In this study, the hypothesis proposed is that the use of Fraction Block media based on deep learning approach has an effect on student learning outcomes. Therefore, to determine whether Fraction Block media based on deep learning media is effective in improving student understanding abilities, an analysis was conducted using a t-test based on the results of the pre-test before treatment and the post-test after treatment. Since $t_{value} = 3.406 > t_{table} = 2.069$, H_0 is rejected and H_1 is accepted. Thus, there is a significant difference between the pre-test and post-test scores after using the Fraction Block Media in fraction material.

Based on the results of research conducted at MTs Cerdas Murni, it was found that the average pre-test score of students was 63.33, which was relatively low, with most students falling into the Very Low (41.67%) and Low (12.50%) categories. Only 33.33% of students reached the Very High category, while no students fell into the Medium category. These findings indicate that before the Fraction Block media was implemented, students' ability to convert common fractions into mixed fractions and vice versa was still not optimal. After the treatment using the Fraction Block media, there was an increase in the average post-test score to 72.5, with a more even distribution of scores: Very High (29.17%), High (25.00%), Moderate (16.67%), Low (12.50%), and Very Low (16.67%). This increase shows that the Fraction Block media has a positive impact in helping students understand the concept of fractions.

The results of the analysis using the t-test further strengthen these findings, where the value obtained is tvalue = 3.406 > ttable = 2.069 at a significance level of $\alpha = 0.05$. This means that there is a significant difference between the pre-test and post-test scores, so H_0 is rejected and H_1 is accepted. Thus, the use of Fraction Blocks has been proven effective in improving students' understanding of fractions, especially in converting common fractions into mixed fractions.

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Discussion

The initial assessment conducted at *Madrasah Tsanawiyah* Cerdas Murni revealed a significant gap in the mathematical proficiency of 24 7th-grade students regarding fraction conversion. Data gathered during the *pre-test* phase showed an average score of only 63.33, which falls into a relatively low category according to established academic standards. A detailed examination of the frequency distribution highlighted that 10 students, or 41.67 percent of the total sample, were situated in the very low performance bracket. Meanwhile, only 8 students managed to reach the very high category, representing 33.33 percent of the class. The absence of any students in the medium category further suggests a polarized understanding of how to convert common fractions into mixed fractions. This baseline data indicates that traditional instructional methods previously employed were insufficient in bridging the conceptual hurdles faced by the learners. Without intervention, the majority of the class struggled with the abstract nature of fractional arithmetic, emphasizing a clear and urgent need for a more tactile and engaging pedagogical strategy to improve these fundamental skills (Bruce et al., 2023; Lemonidis et al., 2020; Merkel et al., 2025; Zhang et al., 2021).

Following the implementation of the *Fraction Block Media* combined with a *deep learning* approach, the 24 students underwent a *post-test* to evaluate their progress. The results demonstrated a noticeable upward shift in academic achievement, as the class average rose to 72.5. This new mean successfully surpassed the mastery standard of 70 set by the researchers, indicating that 72.5 percent of the maximum score was achieved collectively. The frequency distribution became more balanced dibandingkan with the initial phase, with 7 students reaching the very high category and 6 students achieving a high score. Although 4 students remained in the very low category, the overall movement toward the moderate and higher brackets signifies that the manipulative media effectively addressed diverse learning needs. The transition from abstract rote memorization to a more hands-on exploratory proses allowed students to visualize the structural relationships between different types of fractions. This tangible interaction helped demystify the conversion process, turning a previously daunting mathematical task into a manageable and interactive exercise that resonated with a larger portion of the 7th-grade cohort. This improvement underscores the efficacy of integrating tangible learning tools to overcome cognitive barriers associated with abstract mathematical concepts, consistent with findings that highlight the positive impact of concrete media on conceptual understanding (Abrenica, 2025; Akhsanunadia & Arifin, 2026; Foulkes et al., 2023; Hardiningtyas et al., 2025; Ochogboju & Díez-Palomar, 2025).

The statistical validity of the observed improvement was confirmed through a rigorous *t-test* analysis comparing the *pre-test* and *post-test* outcomes. With a calculated t_{value} of 3.406 against a t_{table} of 2.069 at a significance level of 0.05, the null hypothesis was formally rejected. This mathematical evidence proves that the 9.17 point increase in average scores was not a result of random chance but was directly influenced by the specific instructional intervention. The substantial margin between the calculated and table values underscores the reliability of the *Fraction Block Media* in enhancing student comprehension. By rejecting the null hypothesis, the research confirms that tactile tools provide a superior framework for learning fraction material compared to non-manipulative methods. This empirical grounding is essential for justifying the adoption of such innovations in broader educational settings. The data suggests that when students are provided with the right cognitive scaffolds, they can overcome significant academic deficits within a relatively short research period. Consequently, the statistical results provide a robust foundation for the effectiveness of integrating specialized

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media into the 7th-grade mathematics curriculum (Andani & Arifin, 2026; Reinhold et al., 2020; Sholichah & Rahayuningsih, 2025; Yuniarto et al., 2025).

The effectiveness of the *Fraction Block Media* is largely rooted in its ability to transform abstract mathematical operations into concrete visual representations. Fractions are often perceived as difficult because they require students to manipulate numbers that represent parts of a whole, a concept that is inherently less intuitive than whole-number counting. By using physical blocks, students could see and touch the equivalence between improper and mixed fractions, facilitating a more profound internalization of the logic behind the formulas. This *deep learning* strategy encourages learners to move beyond simple procedural drills toward a holistic understanding of how numbers relate to one another spatially. As students physically rearranged the blocks, they were actively constructing their own mental models of fractional values, which is far more efektif than passive observation. The interactive classroom atmosphere fostered by this media juga increased student engagement and reduced the anxiety often associated with complex mathematics. This tactile approach effectively bridges the gap between basic arithmetic and the more advanced algebraic thinking required in later stages of secondary education, ensuring a more solid conceptual footing (Desanjaya et al., 2025; Susanti, 2025; Winarto et al., 2024).

Despite the significant successes recorded during this study, certain limitations must be acknowledged to provide a balanced perspective on the findings. The research was focused on a specific sample of 24 students at *Madrasah Tsanawiyah* Cerdas Murni, meaning the results may vary in different institutional contexts or larger class sizes. Additionally, the short duration of the treatment period implies that while immediate gains were impressive, long-term retention of ini conversion skills requires further investigation. Future studies might explore how these manipulative tools perform across a wider range of mathematical topics beyond just fractions. Namun, the current data remains a compelling indicator of how innovative media can revitalize a classroom. The conclusion remains clear: the integration of *Fraction Block Media* significantly enhanced the learning outcomes of 7th-grade students, raising the average from 63.33 to 72.5. By meeting and exceeding the 70 percent mastery threshold, this pedagogical intervention proved its worth as a viable alternative for teachers seeking to improve numeracy. It stands as a testament to the power of hands-on learning in making difficult mathematical concepts accessible and enjoyable for every student.

CONCLUSION

Based on the results of research conducted at MTs Cerdas Murni, it can be concluded that the use of Fraction Blocks based on deep learning approach is effective in improving seventh-grade students' understanding of fractions, particularly in the material on converting common fractions and mixed fractions. This is demonstrated by an increase in the average student score from 63.33 (low category) on the pre-test to 72.5 (above the minimum passing score of 70) on the post-test. The t-test results show that there is a significant difference between the pre-test and post-test scores ($t_{value} = 3.406 > t_{table} = 2.069$), proving that the use of Fraction Block media based on deep learning approach has a positive effect. In addition, this media is able to help students build a more concrete understanding through visual and manipulative activities, as well as increase student activity to learn. Thus, Fraction Block media is suitable as an alternative mathematics learning media to overcome students' difficulties in understanding fractions while improving their learning outcomes.

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