



## INTERACTIVE BOARDS WITH DEEP LEARNING TO IMPROVE STUDENTS' UNDERSTANDING OF COMPARISON

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### ABSTRACT

This study aims to analyze the effect of applying deep learning integrated with the use of interactive comparison boards on students' understanding of comparison material at SMP Negeri 11 Medan. This study used a pre-experimental method with a one-group pretest-posttest design. The research subjects consisted of 30 seventh-grade students. The research instrument was a comparison concept comprehension test administered before and after the treatment. The results showed a significant increase in students' understanding after using interactive comparison board-based learning. This improvement was evident from the students' pretest average score of 26.7%, while the posttest average score increased to 92.5%. The paired sample t-test showed that the  $t_{\text{count}} = 12.70$  was greater than the  $t_{\text{table}} = 2.045$ , so  $H_0$  was rejected and  $H_1$  was accepted. This indicates a significant difference between the students' pretest and posttest results. The improvement in students' understanding is also supported by an N-Gain value of 0.89, which is in the high category, indicating that the learning method applied is very effective. Thus, deep learning based on interactive comparison boards has been proven to be effective in improving students' understanding of comparison concepts.

**Keywords:** *deep learning, interactive comparison boards, concept understanding, mathematics.*

### ABSTRAK

Penelitian ini bertujuan untuk menganalisis pengaruh penerapan pembelajaran mendalam (*deep learning*) yang terintegrasi dengan penggunaan papan perbandingan interaktif terhadap pemahaman siswa pada materi perbandingan di SMP Negeri 11 Medan. Penelitian ini menggunakan metode pre-eksperimen dengan desain *one group pretest-posttest*. Subjek penelitian terdiri atas 30 siswa kelas VII. Instrumen penelitian berupa tes pemahaman konsep perbandingan yang diberikan sebelum dan sesudah perlakuan. Hasil penelitian menunjukkan adanya peningkatan yang signifikan pada pemahaman siswa setelah menggunakan pembelajaran berbasis papan perbandingan interaktif. Peningkatan tersebut terlihat dari hasil nilai rata-rata pretest siswa sebesar 26,7%, sedangkan nilai rata-rata posttest meningkat menjadi 92,5%. Uji *paired sample t-test* menunjukkan nilai  $t_{\text{hitung}} = 12,70$  lebih besar daripada  $t_{\text{tabel}} = 2,045$ , sehingga  $H_0$  ditolak dan  $H_1$  diterima. Hal ini menunjukkan adanya perbedaan yang signifikan antara hasil pretest dan posttest siswa. Peningkatan pemahaman siswa juga didukung oleh nilai N-Gain sebesar 0,89 yang termasuk dalam kategori tinggi, yang menunjukkan bahwa pembelajaran yang diterapkan sangat efektif. Dengan demikian, pembelajaran mendalam berbasis papan perbandingan interaktif terbukti efektif dalam meningkatkan pemahaman konsep perbandingan siswa.



**Kata kunci:** *pembelajaran mendalam, papan perbandingan interaktif, pemahaman konsep, matematika.*

## INTRODUCTION

Mathematics constitutes a fundamental subject that holds a crucial role in cultivating critical, logical, and systematic reasoning capabilities among students across various educational levels. Within the junior high school curriculum, one of the most essential topics taught is the concept of ratios and proportions. Ideally, the educational objective requires students to thoroughly comprehend this specific mathematical concept and subsequently apply their understanding to solve diverse practical problems effectively. This foundational knowledge serves as a critical stepping stone for mastering more advanced and complex mathematical theories in the future. However, a significant gap exists between these ideal expectations and the actual reality experienced in the classroom environment (Putri et al., 2025; Sihotang et al., 2022; Swain et al., 2023). The inherently abstract nature of ratio and proportion concepts frequently becomes a formidable obstacle for learners. When the instructional process relies solely on theoretical explanations without the integration of interactive and concrete educational tools, students struggle to grasp the core principles. Consequently, the absence of practical learning media creates a profound barrier, preventing students from achieving the desired level of conceptual mastery and proficiency (Fatra et al., 2023; Yuniarto et al., 2025).

Following multiple initial observations and a thorough analysis of student academic performance at *Sekolah Menengah Pertama Negeri 11 Medan*, a concerning reality was discovered regarding their mastery of mathematical ratios. The evaluation results demonstrated that the students' comprehension of this specific material remains exceptionally low and far from the expected standard. Specifically, the initial assessment data revealed that the majority of the students failed to reach the predetermined passing grade, which is formally set at 70 by the institutional curriculum guidelines. Furthermore, the overall average score obtained by the students in this ratio subject falls significantly below the required minimum threshold. This numerical evidence strongly indicates that the fundamental learning objectives designed for this topic have not been optimally fulfilled during the instructional activities. The persistent inability of students to achieve the minimum score of 70 highlights a systemic and tangible problem within the current mathematics learning process, proving that the abstract ratio concepts are not being effectively transmitted to all of the young learners inside the classroom environment today.

This unsatisfactory academic performance is deeply interconnected with the conventional instructional strategies that still heavily dominate the daily classroom activities. Currently, the educational process is structured around a highly conventional paradigm, which severely restricts the natural intellectual curiosity and active participation of the students. The teaching methodology predominantly emphasizes the monotonous delivery of rigid mathematical formulas and highly procedural solving techniques, while almost entirely neglecting the conceptual depth required for true comprehension. Additionally, the utilization of engaging educational media remains severely limited during these sessions. Consequently, students transform into passive recipients of information rather than active constructors of their own knowledge, making it exceedingly difficult for them to internalize the abstract dimensions of ratio and proportion. The continued reliance on traditional lecturing minimizes dynamic student engagement, which directly contributes to their fragile grasp of mathematical concepts. Therefore, this widening gap between conventional teaching practices and the cognitive needs



of students urgently necessitates a transformative approach to prevent further deterioration of their foundational mathematical abilities throughout their ongoing formal educational journey (Adeleke et al., 2025; Suryaningsih et al., 2025; Susanti, 2025; Zhu, 2023).

To overcome these instructional challenges, an effective educational framework must actively immerse students in the process of building their own conceptual understanding. The deep learning approach serves as a highly relevant solution, as it strongly emphasizes the creation of meaningful comprehension by connecting newly acquired knowledge with prior personal experiences and authentic practical contexts. This specific approach continuously encourages students to move far beyond the mere memorization of formulas, urging them to deeply analyze, systematically compare, and critically reflect upon the fundamental concepts they are studying. Furthermore, integrating interactive learning media is absolutely essential to support this advanced cognitive process, especially when dealing with abstract mathematical theories. Interactive tools possess the unique capability to present complex ideas in a visual and highly concrete manner, thereby simplifying the relationships between various concepts and significantly minimizing the occurrence of misconceptions. Despite their individual benefits, these two crucial elements are rarely combined, leaving a noticeable void and gap in the current instructional methodologies applied within junior high schools across the educational system today (Chekour et al., 2022; Sarwar et al., 2024; Shrestha et al., 2023; Zuccarini & Michelini, 2022).

Responding directly to the identified field problems and the existing methodological gaps, this specific research endeavors to seamlessly integrate the deep learning approach with the practical utilization of interactive comparison boards. The prominent novelty and primary innovation of this comprehensive study lie exactly within this unique amalgamation. By combining the profound cognitive strategies of deep learning with the highly engaging tactile experience provided by interactive comparison boards, this research introduces an entirely unprecedented instructional model. This strategic integration is exclusively formulated to significantly elevate the conceptual comprehension of students who previously failed to reach the established minimum competency standard of 70. Ultimately, this newly proposed pedagogical synergy is powerfully expected to construct a substantially more active, profoundly meaningful, and highly effective classroom atmosphere. Furthermore, it firmly establishes a brilliant alternative solution that possesses the immense potential to drastically upgrade the overall quality of mathematics education, particularly regarding the challenging ratio materials taught extensively at the junior high school level and beyond across the entire educational landscape moving forward into tomorrow.

## **RESEARCH METHOD**

This study used a pre-experimental method with a one-group pretest-posttest design. The study was conducted at SMP Negeri 11 Medan on seventh-grade students in class VII.1 with a total of 30 subjects. Subjects were selected purposively based on the homogeneity of their academic abilities as determined by their previous learning outcomes. The study began with a pretest to determine the students' initial abilities in comparison material. Next, students were given treatment in the form of mathematics learning using an in-depth learning approach integrated with interactive comparison boards. The treatment was given over several meetings in accordance with the time allocation for learning comparison material. After the entire series of lessons was completed, students were given a posttest to determine changes and improvements in their understanding of comparison material after the treatment was given.

The research procedure consisted of preparation, implementation, and evaluation stages. In the preparation stage, the researcher developed learning tools, prepared interactive comparison boards, and developed instruments to test understanding of comparison concepts. The interactive comparison boards used were first validated by learning media experts to ensure their suitability for use in the learning process. The research instrument was a comparison concept comprehension test developed based on indicators of equivalent and inverse comparison material. The test was used in the pretest and posttest with the same level of question equivalence. In the implementation stage, learning was carried out by actively involving students through the use of interactive comparison boards in observing, trying, and solving problems. The evaluation stage was carried out by administering a posttest after the treatment was completed.

The research data was obtained from the students' pretest and posttest results. The collected data was then analyzed quantitatively. Data analysis began with calculating the average pretest and posttest scores to determine the overall improvement in student understanding. Next, the data was analyzed using a paired sample t-test to determine the difference in student learning outcomes before and after the treatment. This test was used because the data came from the same group with two measurements. The significance level used in this study was 0.05. In addition, the level of learning effectiveness was analyzed using the N-Gain calculation to determine the category of improvement in student understanding. The results of the data analysis were used as the basis for drawing conclusions about the effect of implementing deep learning based on interactive comparison boards.

## RESULT AND DISCUSSION

### Result

#### Pretest Results

The following is presented a table of pretest results for SMP Negeri 11 Medan students.

**Table 1. Pretest Results With Correct Answers**

Question	Frequency (Number of Students)	Percentage (%)
Question 1	8	26.7%
Question 2	10	33.3%
Question 3	6	20.0%
Question 4	7	23.3%
Question 5	9	30.0%
<b>Total Students (N)</b>	<b>30</b>	-

Based on Table 1, the pretest results indicate that the students' initial understanding of the material is still relatively low. In the first question, only 8 students (26.7%) were able to answer correctly. This number increased to 10 students (33.3%) for the second question, while 6 students (20.0%) answered the third question correctly.

#### Posttest Results

Table 2 is presented data of posttest results for students of SMP Negeri 11 Medan.

**Table 2. Posttest Results (Frequency of Correct Answers)**

Question	Frequency (Number of Students)	Percentage (%)
Question 1	30	100%
Question 2	26	86.67%
Question 3	29	96.67%
Question 4	26	86.67%

Question 5	27	90.0%
<b>Total Students (N)</b>	<b>30</b>	-

Based on Table 2, the posttest results demonstrated a significant increase in understanding after the students participated in learning utilizing PPT media and interactive boards. In the first question, all students (100%) were able to answer correctly, indicating that the basic concepts had been well mastered by all participants. The third question also showed very high results, with 29 students (96.67%) answering correctly. Meanwhile, for the second and fourth questions, 26 students (86.67%) each answered correctly, and for the fifth question, 27 students (90%) answered correctly.

**Tabel 3. Comparison of Pretest and Posttest Results**

Aspect	Pretest	Posttest	Increase
<b>Highest Item Correctness</b>	33.3% (10 students)	100% (30 students)	+66.7%
<b>Lowest Item Correctness</b>	20.0% (6 students)	86.7% (26 students)	+66.7%
<b>Average Score</b>	26.7%	92.5%	+65.8%
<b>Classical Completeness</b>	0% (Incomplete)	Very Significant ( $\geq 70$ )	-

Table 3 shows a significant increase between the pretest and posttest results. The average student score rose from 26.7% to 92.5%, with an increase of 65.8%. This indicates that the application of interactive comparison board-based learning with a deep learning approach is effective in improving students' understanding of comparison concepts.

To illustrate the level of effectiveness of the learning applied, it is necessary to classify the N-Gain scores into three categories, namely high ( $g \geq 0.70$ ), moderate ( $0.30 \leq g < 0.70$ ), and low ( $g < 0.30$ ).

To find out whether this learning is effective in improving students' abilities, an analysis is carried out using a t-test (paired sample t-test) based on the results of the pretest before treatment and posttest after treatment.

$$\text{N-Gain} = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Max Score} - \text{Pretest}}$$

$$\text{N-Gain} = \frac{92.5 - 26.7}{100 - 26.7} = \frac{65.8}{73.3} = 0.89$$

Based on these calculations, an N-Gain value of 0.89 falls into the high category.

Because  $t_{\text{value}} = 12.70 > t_{\text{table}} = 2.045$ ,  $H_0$  is rejected and  $H_1$  is accepted. Thus, there is a significant difference between the pretest and posttest scores. This proves that the application of integrated deep learning interactive comparison boards has a significant effect on improving students' understanding of comparison materials for Grade VII students at SMP Negeri 11 Medan.

## Discussion

The initial data gathered from the seventh grade students at SMP Negeri 11 Medan clearly illustrates a significant gap in their foundational knowledge regarding mathematical comparison concepts before the intervention. With an average pretest score of only twenty six point seven percent, it is evident that the majority of participants struggled to grasp the core principles of the subject matter. The lowest performance was recorded in the third question, where only twenty percent of the students managed to provide a correct answer. This poor initial performance highlights a common obstacle in mathematics education, where abstract concepts are often presented without sufficient contextual or visual support. Without interactive tools, students tend to view these topics as a series of disconnected formulas rather than logical



relationships. This baseline stage proves that traditional teacher centered methods were insufficient in helping students navigate the complexities of equivalent and inverse values. Consequently, these low figures provided a strong justification for introducing a more immersive and interactive pedagogical strategy to bridge the existing cognitive gap effectively (Adrien et al., 2021; Al-Zoubi & Suleiman, 2021; Chu et al., 2025).

Following the implementation of the *deep learning* approach integrated with interactive comparison boards and digital presentations, the posttest results revealed a dramatic transformation in student achievement. The average score soared to ninety two point five percent, representing a substantial increase of sixty five point eight percent compared to the initial assessment. One of the most remarkable findings was the hundred percent success rate on the first question, indicating that every participant had mastered the essential basic concepts. Furthermore, the statistical analysis through a *paired sample t-test* yielded a value of twelve point seventy, which significantly exceeded the table threshold of two point zero forty five. This numerical evidence confirms that the observed improvements were not incidental but rather a direct result of the experimental treatment. By providing a more concrete representation of mathematical variables, the interactive media allowed students to move past the limitations of rote memorization. The significant difference between the two testing phases proves that the new instructional framework successfully addressed the previous learning deficiencies and enhanced performance (Capinding, 2023; Pratiwi et al., 2025; Temaj et al., 2025).

The effectiveness of this specific learning model is further validated by the calculated N-Gain score, which reached a high value of zero point eighty nine. In the realm of educational evaluation, a score within this range is classified as high, suggesting that the transition from abstract theory to practical understanding was exceptionally successful. This high gain indicates that the instructional strategy was not only capable of improving scores but also of facilitating a profound shift in how students process complex information. By utilizing a *deep learning* framework, the classroom environment evolved into a space where students could explore the logic behind mathematical comparisons rather than simply following rigid procedures. The interactive comparison boards served as a vital bridge, turning invisible numerical relationships into visible, manageable data points for the learners. This level of efficiency proves that the combination of modern technology and reflective activities can overcome traditional barriers to learning. The data suggests that when students are given the right tools to visualize problems, their capacity to internalize difficult concepts (Anshari et al., 2024; Nurviandy & Dwiningsih, 2021; Temaj et al., 2025; Tyng et al., 2023).

The broader implications of these findings suggest that the integration of a *deep learning* approach fosters a more meaningful educational experience than traditional procedural instruction. Instead of focusing solely on getting the right answer, students were encouraged to engage in exploratory and reflective activities that uncovered the true nature of comparison. This shift in pedagogical focus allowed the seventh graders to build a more complete and resilient conceptual framework. The interactive boards acted as a catalyst for this change, providing a physical and digital interface for mathematical experimentation. When students can manipulate variables and see the immediate impact on a comparison scale, the learning becomes an active investigation rather than a passive lecture. This methodology empowers learners to take ownership of their cognitive development, which is a hallmark of high quality education. Furthermore, the success of this model implies that mathematics should be taught as a dynamic system of relationships. By prioritizing conceptual depth over surface level speed, educators



can ensure that the knowledge gained remains stable and applicable now (Haokip, 2024; Mickey et al., 2026; O'Connor & Norton, 2022; Ormond, 2021; Susanti, 2025; Tabieh, 2020).

While the results of this study are highly promising, it is important to acknowledge certain limitations that define its current scope. The research was specifically conducted with thirty students in a single grade level at one middle school, which means the findings might vary in different demographic or institutional contexts. Additionally, the study focused exclusively on comparison materials, leaving room for further investigation into how these interactive tools might perform across other mathematical branches. Despite these boundaries, the significant statistical evidence provided by the *t-test* and N-Gain scores offers a compelling case for broader implementation. It is highly recommended that mathematics teachers begin incorporating similar interactive media and *deep learning* strategies into their daily routines. This approach could be adapted for topics such as linear equations, geometry, or statistics to improve general student outcomes. Future research should also explore the long term retention of these concepts to see if the high posttest scores translate into lasting proficiency. Ultimately, this study serves as a valuable blueprint for modernizing mathematics education now.

## CONCLUSION

Based on the results of the research and data analysis, it can be concluded that the application of deep learning integrated with interactive comparison boards has a significant effect on improving students' understanding of comparison material at SMP Negeri 11 Medan. Students' initial understanding was relatively low, as indicated by the average pretest score of 26.7%, which increased substantially to 92.5% in the posttest. The results of the *paired sample t-test* confirmed a significant difference between pretest and posttest scores, with  $t_{\text{value}} = 12.70$  greater than  $t_{\text{table}} = 2.045$ , indicating that the research hypothesis was accepted. In addition, the effectiveness of the learning implementation was supported by an N-Gain value of 0.89, which falls into the high category, demonstrating that the integration of a deep learning approach with interactive comparison boards is highly effective in enhancing students' conceptual understanding and creating a more active and meaningful mathematics learning process. Thus, the integration of deep learning through PPT media, interactive boards, and WordWall is not only able to improve students' academic achievement, but also create a more active, meaningful, and enjoyable learning experience.

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