Jurnal Pendidikan Matematika Universitas Lampung
Vol. 13, No. 3, 2025, pp. 157 – 171
https://jurnal.pbs.fkip.unila.ac.id/index.php/jpm/
ISSN: 2715-856X

Effect of Deep Learning Approach With GeoGebra-Based Interactive PowerPoint and Animated Videos on Concept Understanding

Nur Silvina[1], Abednego Pradja Tumanggor[2]*, Adelia Br Tarigan[3], Dara Muna Lubis[4]
Mikhael Agus Tua Sibarani[5], Budi Halomoan Siregar[6]

Universitas Negeri Medan, Medan, Indonesia

[1]nursilvina.4222411002@mhs.unimed.ac.id, [2]abendnego.4223111077@mhs.unimed.ac.id*, [3]adeliabrtarigan.4222411003@mhs.unimed.ac.id, [4]darmunn.4221111021@mhs.unimed.ac.id, [5]mikhaelsbr.4222411023@mhs.unimed.ac.id, [6]budihalomoan@unimed.ac.id

* corresponding author

ARTICLE INFO

Article history
Received: 14 June, 2025
Revised: 6 August, 2025
Accepted: 20 September, 2025
Published: 24 September, 2025

Keywords
geogebra;
deep learning;
interactive PowerPoint;
animate video;
straight line equations

ABSTRACT

This study focused on identifying the magnitude of the impact of a deep learning approach assisted by GeoGebra-based interactive PowerPoint media and animated videos on junior high school students' conceptual understanding, particularly on the topic of straight-line equations. The research employed a quasi-experimental methodology with a pretest–posttest design involving two groups: the experimental group and the comparison group. The measurement instruments consisted of essay questions, and the data were analyzed using normality testing, homogeneity testing, and an independent t-test. The findings revealed a significant improvement in the experimental group's conceptual understanding. The higher average posttest score compared to the control group confirmed that the use of interactive media enhanced students' understanding of the material in a more visual and engaging way. Furthermore, the deep learning strategy optimized students' active involvement in understanding and connecting relevant material to real-life situations. Thus, the synergy between digital media and this learning strategy was proven to effectively enhance conceptual understanding.

How to Cite: Silvina, N., Tumanggor, A. P., Tarigan, A. B., Lubis, D. M., Sibarani, M. A. T., & Siregar, B. H. (2025). Effect of Deep Learning Approach With GeoGebra-Based Interactive PowerPoint and Animated Videos on Concept Understanding. *Jurnal Pendidikan Matematika Universitas Lampung*, 13(3), 157-171. http://dx.doi.org/10.23960/mtk/v13i3.pp157-171

INTRODUCTION

Mathematics is a field of study that has a crucial role in developing students' advanced thinking skills, including the ability to think logically, critically, analytically, and structurally (Husnaidah et al., 2024). At the junior high school (SMP) level, mathematics is not only a core subject, but also an important instrument to build a strong foundation of scientific thinking for students. Mathematics learning does not only emphasize mastery of algorithms and procedures, but also focuses on deep understanding of concepts, especially in linking symbolic, visual, and contextual representations (Zulmaulida et al., 2021). This requires students to not only memorize the solution steps, but also understand the meaning behind each procedure and symbol used, both in solving mathematical problems and in their application in everyday life. However, previous studies have shown that achieving this integration between symbolic, visual, and contextual representations is not always successful, particularly when learning relies heavily on conventional methods without sufficient interactive elements.

The success of mathematics learning can be measured by students' achievement in mastering mathematical concepts, namely the ability to recognize, interpret, and apply mathematical principles in various forms of representation and situations. According to Ndani & Erita (2023), understanding mathematical concepts is an essential aspect in learning mathematics because it plays a role in shaping the flexibility of thinking and the ability to transfer knowledge to new situations. Concept understanding refers to students' ability to understand, explain, and apply concepts flexibly and appropriately. Tarisa & Manan (2024) stated that concept understanding includes the ability to restate concepts, classify objects based on concepts, apply concepts in problem solving, and connect various concepts internally and externally. Deep understanding is needed so that students not only memorize formulas or procedures, but also master the essence of concepts and apply them in various contexts (Nabila et al., 2025). Without deep understanding, students tend to have difficulty solving problems that are presented in a different format from what they are used to (Lumbantobing, 2023). Thus, mathematics learning needs to be designed in a meaningful and contextual manner, so that students are able to master and relate concepts as a whole, not just memorize mechanistic procedures. This suggests that even when the importance of conceptual understanding is acknowledged, the challenge lies in designing learning that consistently bridges abstract theory and real-life application.

Ziliwu et al. (2022) mention that one of the mathematics topics that often becomes a challenge for junior high school students in building conceptual understanding is the Straight Line Equation, as it requires high visualization and abstraction skills. Students are expected to understand the relationship between the algebraic form of a two-variable linear equation ($y = mx + c$) and its graphical representation in the Cartesian coordinate system, as well as its connection to contextual phenomena in everyday life. However, while some studies have succeeded in using visual media to support this process, others found that without active engagement strategies, students may still perceive the graphical and algebraic forms as separate entities, limiting conceptual transfer. This distinctive characteristic of straight line equations—demanding both abstraction and concrete visualization—makes the topic particularly suited for a deep learning approach, as it encourages students to integrate multiple representations (algebraic, graphical, and contextual) into a coherent understanding. Prior research has explored alternative approaches, such as drill-based exercises (Lumbantobing, 2023) or the exclusive use of visualization tools like GeoGebra (Hikmah & Nengsih, 2021), yet these methods often fail to ensure students' active engagement in meaningfully connecting representations.

Thus, combining deep learning strategies with interactive media becomes highly relevant to optimize students' conceptual understanding of straight line equations.

Initial observations at SMP Negeri 5 Percut Sei Tuan showed that students still have difficulty in understanding the concept of straight line equations, which is reflected in the low level of mastery of the material. This can be seen from students' inability to interpret graphs correctly and difficulty in connecting graphical representations with the form of the equation. Students tend to just memorize the formula without understanding the conceptual meaning contained in it. This condition shows a gap between the level of abstraction of the material presented and the students' ability to visualize it concretely. One of the contributing factors is that the learning strategies used are still conventional, as well as the limited learning media used, which generally only rely on boxed whiteboards and textbooks. This aligns with findings from similar schools, where limited exposure to dynamic visual tools leads to a reliance on rote learning and low adaptability when problems are presented in unfamiliar contexts.

This situation indicates the need for an alternative approach that can bridge the gap between the abstraction of mathematical concepts and students' concrete and contextual learning experiences. In this context, the use of interactive and visual learning media is crucial. This type of media is not limited to the function of building concept understanding, but also optimizing student motivation and participation in the learning process (Aulia et al., 2024). Thus, interactive technology can be an alternative to improve the quality of mathematics learning, especially in abstract materials such as straight line equations. (Susanti et al., 2023). However, previous implementations of interactive technology vary in effectiveness, suggesting that media choice and integration into pedagogy are critical to achieving the desired learning outcomes.

The deep learning approach in education is a method that emphasizes deep conceptual understanding, critical reflection, and knowledge integration. Mutmainnah et al. (2025) stated that this approach encourages students' active involvement through activities such as simulations, experiments, and discussions, which present a rewarding and enjoyable learning process for students. The deep learning strategy facilitates students not only in mastering the material, but also in connecting the concept with the reality of life. This makes students' understanding more lasting because it is formed through an integrative and reflective process (Basuni et al., 2025). Yet, without suitable media support, deep learning risks remaining theoretical, as abstract topics like straight line equations require concrete visualization tools to make reflection and integration more meaningful.

Deep learning emphasizes learning that is not only memorizing but also mastering and relating concepts to real contexts. This approach supports comprehensive concept understanding through strategies that focus on knowledge integration, self-reflection and meaningful learning experiences. Mutmainnah et al. (2025) emphasized that this approach, not only focuses on cognitive development, but also includes affective and psychomotor aspects to support holistic understanding. In practice, this requires selecting learning media that stimulate multiple senses and modes of thinking simultaneously, so that affective and psychomotor elements are not neglected.

The deep learning approach emphasizes deep understanding and active engagement of students in learning. Interactive PowerPoint supports this approach by providing a learning medium that enables exploration, reflection and interaction. Research shows that the transformation of mathematics learning through deep learning using interactive media can improve student motivation and learning achievement (Muhammad et al., 2025). However, while interactive PowerPoint offers structured guidance, without dynamic mathematical simulations it may not fully address students' visualization challenges in topics like straight line equations.

In teaching and learning activities, learning media serves as a very important element, especially in conveying information effectively from teachers to students (Siregar et al., 2024). Media also helps simplify complex and abstract material. Hermawan et al. (2024) found that interactive PowerPoint can increase student motivation, focus, and engagement. The media helps students remember the material longer because it involves the senses of sight, hearing, and practice simultaneously. Sadiman in Setyawati et al. (2020) described the functions of learning media which include clarifying the delivery of messages, overcoming space and time constraints, and enabling the presentation of clearly visualized material. Therefore, the existence of learning media is essential to support the achievement of learning objectives effectively (Siregar et al., 2022). Yet, as effective as interactive PowerPoint can be, prior research rarely examines its limitations when used in isolation, such as the tendency for students to remain passive recipients if interactive features are underutilized.

In the contemporary digital era, the integration of information technology in learning has become an inevitable need (Siregar et al., 2023). The use of interactive digital media has been shown to significantly increase learning motivation, student interest, and concept understanding (Putri, 2024; Hermawan & Hadi, 2024). Interactive PowerPoint is a developed form of conventional presentation media that incorporates animation, hyperlinks, and other interactive elements. This media allows students to learn through visual, auditory, and kinesthetic approaches simultaneously, thus encouraging stronger and sustainable understanding. Izzati et al. (2023) revealed that interactive PowerPoint allows students to better understand concepts because the information is delivered gradually and logically, while attracting their interest in learning. A well-designed interactive PowerPoint can improve students' understanding of mathematical concepts. Kurniawan & Sarjana (2025) revealed that interactive features in the form of quizzes, animations, and hyperlinks provide opportunities for students to actively engage in learning activities, which have an impact on increasing their understanding of the content of the material. Izzati et al. (2023) showed that the use of science-oriented interactive PowerPoint is effective in strengthening the ability to understand mathematical concepts in flat-sided space building material. Despite these strengths, interactive PowerPoint alone may not provide sufficient exploratory capacity for highly abstract content, making its pairing with dynamic mathematical software a promising alternative.

GeoGebra is software that is very useful for the mathematics learning process because it allows visualization of abstract concepts such as gradients, intersections, and line shapes. Hikmah & Nengsih (2021) showed that GeoGebra can help students understand straight line equation material more easily than conventional methods. GeoGebra also supports the process of exploration and experimentation by students, so that learning is no longer one-way. Toolbars on GeoGebra such as midpoints, cut points, and other measuring tools provide teacher flexibility in delivering material accurately. Nonetheless, some studies note that without pedagogical guidance, students may focus on manipulating the software rather than developing deeper conceptual links, highlighting the need for structured integration.

Video animation is a learning media that utilizes moving visual technology to convey material. This media is proven to be able to increase the effectiveness of learning because it presents information in an interesting, structured, and memorable manner. Hidayah & Amelia (2023) found that the use of animated videos in learning resulted in learning outcomes that improved more significantly than conventional learning methods. Animated videos are an effective medium to deepen students' understanding of mathematical concepts by presenting material in a visual and interesting way. The effectiveness of the 'Picnic with Math' video animation can be seen from the improvement of mathematical concept mastery of fifth grade students on the subject of building spaces (Nurhayati et al., 2025). This media is also suitable for overcoming concept understanding difficulties that usually occur in visual materials such as straight line equations, where students need to understand graphical representations, points, and gradients concretely. However, animated videos tend to be one-directional; without opportunities for interaction or immediate feedback, their impact on active problem-solving skills may be limited.

The integration of interactive PowerPoint with GeoGebra allows for a more dynamic and visual presentation of math materials. GeoGebra can be embedded in PowerPoint slides to provide interactive simulations that help students understand abstract concepts concretely. Muliyana et al. (2022) stated that learning media that combines PowerPoint and GeoGebra is effective for deepening students' understanding of flat-sided space building material. The use of animated videos in interactive PowerPoint can increase the attractiveness and understanding of the material by students. Animated videos help explain complex concepts through interesting visualizations. A comparative study showed that both interactive PowerPoint and animated videos were effective in strengthening junior high school students' understanding of the concept of whole numbers (Rahmansyah & Warli, 2024). The evidence indicates that integrating these media allows educators to maximize the strengths of each, such as the structured presentation offered by PowerPoint, the interactive and dynamic features of GeoGebra, and the engaging appeal of videos, while simultaneously addressing the limitations inherent in each medium.

Learning media such as interactive PowerPoint, GeoGebra, and animated videos can bridge students from superficial understanding to meaningful understanding. Hikmah & Nengsih (2021) showed that the use of GeoGebra in learning straight line equations can optimize student understanding compared to conventional methods. In line with that, animated videos are proven to make it easier for students to remember and understand visual material, so that understanding of the concepts of line, gradient, and intersection point becomes more optimal (Hidayah & Amelia, 2023). Yet, previous studies rarely combine all three, leaving an open question about their combined effect under a deep learning framework.

Previous studies have indicated that the use of interactive media, such as GeoGebra and animated videos, has high effectiveness in supporting the learning process. Research by Ziatdinov & Valles Jr. (2022) showed that GeoGebra provides a visual and interactive environment that can encourage deeper engagement and mastery of mathematical concepts, through the integration of modeling, visualization, and mathematical programming. In the context of learning mathematics in junior high school, the use of animated videos has also been proven effective. Sitompul et al. (2024) showed that the implementation of animated videos as visual aids was effective in supporting the learning process and optimizing the achievement of learning outcomes of seventh grade students. Suhra et al. (2023) also confirmed that animated videos are effective in improving concept understanding of VIII grade students of SMP Negeri 2 Majene. Nevertheless, little is known about whether combining these media with structured deep learning activities could yield greater gains than using them individually.

Interactive digital media such as PowerPoint, GeoGebra, and animated videos support the key principles of the deep learning approach. They enable students to experience an active, reflective, and meaningful learning process. In this context, media is not just a visual aid, but also a means to build student interaction, exploration, and deep engagement in learning. Combining this media with the deep learning approach provides a learning experience that is not only informative, but also transformative, where students truly understand the meaning of the material learned, not just memorize it (Hermawan et al., 2024). This integration is expected to bridge the gap between theory and practice, addressing both cognitive and motivational challenges in learning straight line equations.

Although prior studies have separately demonstrated the effectiveness of interactive PowerPoint (Hermawan & Hadi, 2024), GeoGebra (Hikmah & Nengsih, 2021), and animated videos (Hidayah & Amelia, 2023), each of these media alone has limitations: PowerPoint often risks encouraging passive reception, GeoGebra tends to emphasize technical manipulation over conceptual reasoning, and animated videos, while attractive, lack interactivity. To date, little research has systematically combined these complementary media within a deep learning framework. This study examines the impact of implementing such an integration—deep learning assisted by GeoGebra-based interactive PowerPoint and animated videos—on the conceptual understanding of class VIII students of SMP Negeri 5 Percut Sei Tuan, particularly in straight line equation material. The innovation of this study lies not only in the combination itself but also in how the synergy of these media is designed to address the specific shortcomings identified in earlier approaches, providing a more balanced, visual, dynamic, and contextual learning experience. The findings of this research are expected to serve as a practical guide for teachers in developing innovative strategies that enhance students' active engagement, motivation, and conceptual understanding. By explicitly targeting the weaknesses of prior methods and filling a gap in the literature, this study offers a novel model for integrating complementary media under a deep learning framework.

METHOD

This study applied a quasi-experimental methodology with a quantitative approach to measure the impact of implementing a deep learning approach assisted by geogebra-based interactive powerpoint media and animated videos on the understanding of the concepts of class VIII students at SMP Negeri 5 Percut Sei Tuan on the material of straight line equations. This method was chosen because the research was conducted in a class that had been formed, so that random grouping of students could not be done. The population in this study comprised all eighth-grade students at SMP Negeri 5 Percut Sei Tuan. The sample was obtained through a random sampling technique, selecting 20 students from each of two classes, one assigned as the experimental group and the other as the control group. This randomization ensured that every class had an equal chance of being chosen, making the sample representative of the population. The selection process was conducted using a lottery, where each class number was written on identical pieces of paper, placed into a container, mixed thoroughly, and two papers were randomly drawn to determine the sample classes. Quantitative methods are applied to evaluate the improvement of learning achievement through pretest and posttest tests in both groups. Statistical analysis such as t-test will be used to compare the results between the two groups. Data analysis calculations will be done through R Studio version 4.4.1.

The research design applied was pretest-posttest with a control group as a comparison to the experimental group. This design can be observed in Table 1.

Table 1. One Group Pretest-Posttest Design

X	P_1	X	P_2
O	P_1	-	P_2

Description:
X : Experiment Class
O : Control Class
P : Test

The instrument used in this study was an essay test on the topic of straight line equations, including five questions for the pretest and five questions for the posttest. In the validity test, the researcher worked with 27 participants as the sample, applying a 5% (0.05) margin of error. With this sample size, the degrees of freedom were calculated as 27 – 2 = 25, resulting in an r-table value of 0.396. The analysis identified 5 items that met the validity criteria and 5 items that did not. An item was considered valid if its r-calculated exceeded the r-table value of 0.396 for $\alpha = 0.05$ with N = 27. Conversely, items with r-calculated lower than the r-table were deemed invalid. The 5 valid items were then used for both the pretest and posttest. Reliability testing produced a coefficient of 0.273421, indicating that, overall, the instrument was considered reliable. Hypothesis testing was carried out using inferential data analysis regarding the effect of deep learning approach assisted by geogebra-based interactive powerpoint media and animated videos on the concept understanding of class VIII students of SMP Negeri 5 Percut Sei Tuan on straight line equation material.

Three types of statistical tests were carried out: (1) Shapiro-Wilk normality test for samples less than 30, with criteria $p > 0{,}05$; (2) Levene homogeneity test with criteria $p > 0{,}05$; and (3) Independent Sample t-test to determine differences in learning outcomes between groups, with $p < 0{,}05$ as the basis for rejecting H_0 and accepting H_a.

RESULTS AND DISCUSSION

Results

The research was conducted on May 23 and 26, 2025 in class VIII of SMP Negeri 5 Percut Sei Tuan with descriptive and inferential data analysis. Descriptive analysis was used to evaluate learning outcomes before and after treatment in both groups based on the average pretest and posttest scores.

Table 2. Results of Descriptive Analysis of Student Learning Outcomes of Straight Line Equation Material

Data	Mean	Std. Deviasi	Varians
Pretest O	41.2	1.361114	1.852632
Posttest O	63.2	1.609184	2.589474
Pretest X	42.15	1.308877	1.713158
Posttest X	84.3	1.174286	1.378947

Based on Table 2, it can be seen that the average value of learning outcomes in both classes has increased. The standard deviation is quite high indicating a large variance in the data, the increase that occurred in the experimental class was more significant when compared to the control class. Before conducting inferential analysis, a normality test was conducted first as a requirement for parametric analysis.

Table 3. Normality Test Results

No	Data	Sig. Value
1	*Pretest* O	0.2618
2	*Posttest* O	0.4993
3	*Pretest* X	0.07227
4	*Posttest* X	0.07684

The normality test results in Table 3 show that the significance values of both groups are above 0.05, so the data is considered normally distributed. The significance value of the control pretest is 0.2618 > 0.05, so the data is normally distributed. The significance value of the control posttest is 0.4993 > 0.05, so the data is normally distributed. The significance value of the experimental pretest is 0.07227 > 0.05, so the data is normally distributed. The significance value of the experimental posttest is 0.07684 > 0.05, so the data is normally distributed. Furthermore, the homogeneity test was carried out using the Levene Test which is presented in Table 4.

Table 4. Homogeneity Test Results

No	Data	Sig.Value
1	*Pretest*	0.8602

2	*Posttest*	0.1439

Table 4 shows that the pretest significance value is 0.8602 > 0.05 which means the pretest data is homogeneous. Then the posttest significance value is 0.1439 > 0.05 which means the posttest data is homogeneous. Therefore, the data meets the requirements of parametric analysis and continues with the Independent Sample t-test whose results are shown in Table 5.

Table 5. Independent T Test Results

Data	Df	Sig
Posttest	19	< 2.2e-16

Based on the results in Table 5, the significance value of the posttest between the experimental class and the control class is 2.2e-16 < 0.05, which shows a significant difference between the two groups. This result means that Ho is rejected and Ha is accepted, indicating that the deep learning approach assisted by geogebra-based interactive PowerPoint media and animated videos has a significant effect on the understanding of the concept of students in class VIII SMP Negeri 5 Percut Sei Tuan on the material of straight line equations.

Discussion

This study showed a significant increase in the understanding of mathematical concepts in students after the application of GeoGebra-based interactive PowerPoint media and animated videos with a deep learning approach. This condition is reflected in the increase in the average posttest score in the experimental class compared to the control class, from 42.15 to 84.3. While in the control class the increase was from 41.2 to 63.2. This difference proves that the use of interactive media in the experimental class makes a greater contribution to deepening students' understanding of mathematical concepts.

Before the application of interactive learning media, many students had difficulty in graphing straight line equations, especially in relating the algebraic form $y = mx + c$ to the position of the line on the coordinate plane. They tended to just memorize the formula without visually understanding the meaning of gradient or intersection point. However, after the implementation of interactive PowerPoint media integrated with GeoGebra and animated videos, students showed significant improvement in relating the coefficient to the direction and location of the line. The visualization of dynamically displayed graphs helps students understand that changes in the values of m and c directly affect the slope and position of the line. This can be seen from the ability of students who are starting to be able to make predictions about the shape of the graph before drawing it, and are more confident when working on graphical representation problems. In other words, the media used succeeded in bridging students' understanding from symbolic abstraction to more concrete visualization..

Based on a study conducted by Hikmah & Nengsih (2021), it shows that GeoGebra can significantly increase student participation and understanding. The application of GeoGebra as an interactive media is effective in helping students to describe abstract concepts in straight line equation material, such as gradient, intersection points, and line graphs. This research shows the correspondence between GeoGebra media and improved student learning outcomes. However, there are differences between these two studies. This study used GeoGebra-based Interactive PowerPoint media and Animated Videos.

Based on the research activities carried out in the classroom, the implementation of deep learning approach is also a crucial element in the success of learning. This approach is implemented through learning strategies that require students to deeply analyze the meaning of slope and constants in linear equations, explore the relationship between graphical representations and algebraic forms, and solve contextual problems that reflect phenomena in everyday life. Students are directed to interpret the coefficients in the line equation as a representation of the rate of change in a real-world context, not just memorizing the formula $y = mx + c$. The use of interactive PowerPoint media integrated with GeoGebra also contributes significantly, because it allows students to manipulate line graphs directly and visually observe the impact of changes in the values of m (gradient) and c (intercept) on the slope and intersection of the graph. This visualization process not only strengthens conceptual understanding concretely, but also encourages the development of reflective abilities, where students are invited to evaluate the results of exploration to verify the understanding gained.

Deep learning, according to Nadawina et al. (2025), is characterized by students' intention to understand meaning and seek connections between ideas, rather than merely reproducing information through surface-level memorization. The indicators of deep learning include students' ability to relate new information to prior knowledge, transform abstract concepts into concrete understanding, and apply learned principles to solve novel problems in different contexts. Furthermore, deep learning is evidenced when students demonstrate metacognitive awareness by reflecting on their learning process, questioning assumptions, and constructing personal meaning from the material rather than passively accepting information.

In addition, activities such as group discussions, drawing conclusions based on the results of digital exploration, and solving conceptual reasoning-based problems are also important factors in increasing students' active involvement and deep thinking skills. This finding is in line with research conducted by Mutmainnah et al. (2025), who asserted that the deep learning approach is effective when students not only acquire information passively, but are also able to reorganize knowledge through a reflective process and link meaning between concepts comprehensively. Thus, the implementation of this approach has the potential to create a learning experience that is not only academically meaningful, but also relevant and applicable in the context of students' real lives.

Not only from the approach, animated videos are proven to make a significant contribution in attracting students' enthusiasm for learning. Material that is delivered in a visually appealing manner makes it easier for students to understand and remember concepts, especially material that requires understanding of graphic representations such as straight line equations. This result is consistent with Hidayah & Amelia's study (2023), which states that animated videos can significantly improve student learning outcomes.

From a cognitive perspective, the effectiveness of GeoGebra-based interactive PowerPoint and animated videos can be explained through the dual coding theory and multimedia learning principles. The simultaneous use of visual and verbal representations reduces cognitive load, helps students build stronger connections between abstract symbols and visual graphs, and supports long-term memory retention. Moreover, interactive manipulation of graphs encourages active engagement, which aligns with constructivist learning theory by allowing students to construct their own understanding through exploration and feedback. In this way, the media not only present information but also facilitate deeper cognitive processing, making learning more meaningful and durable.

The t-test results showed a significant difference between the experimental and control groups, indicating that the application of the deep learning approach combined with GeoGebra-based interactive PowerPoint media and animated videos had a positive impact on students' understanding of mathematics concepts.

CONCLUSION

Based on the research findings and discussion, the application of a deep learning approach assisted by interactive PowerPoint media based on GeoGebra and animated videos has been proven to have a significant and positive impact on improving students' understanding of mathematical concepts in linear equation material. This improvement is evident from the higher average posttest scores in the experimental group compared to the control group. The deep learning approach encourages active student engagement, meaningful understanding, and connections between the material and real-life situations, where GeoGebra facilitates the concrete visualization of abstract concepts, while animated videos make the material more engaging and easier to remember. Practically, these findings recommend that mathematics teachers integrate deep learning strategies with interactive digital media as an alternative learning method, particularly for topics requiring high visual understanding, and encourage further research on other mathematical topics and materials with a larger sample scope.

REFERENCE

Aulia, H., Hafeez, M., Mashwani, H. U., Careemdeen, J. D., Mirzapour, M., & Syaharuddin, S. (2024, March). The role of interactive learning media in enhancing student engagement and academic achievement. *Proceeding of International Seminar on Student Research in Education, Science, and Technology*, 1, 57-67.

Basuni, B., Mikraj, H., Rustam, R., Ahmad, D., Zubaidah, Z., Winarji, A., ... & Junarti, J. (2025). Moral message-based deep learning in mathematics instruction for Mathematics MGMP teachers of Kubu Raya. *International Journal of Public Devotion*, 8(1), 59-70. https://dx.doi.org/10.26737/ijpd.v8i1.4722

Hermawan, A., & Hadi, S. (2024). Realitas pengaruh penggunaan teknologi augmented reality dalam pembelajaran terhadap pemahaman konsep siswa. *Jurnal Simki Pedagogia*, *7*(1), 328-340. https://doi.org/10.29407/jsp.v7i1.694

Hermawan, T., Khairiani, D., Muthmainnah, M., Saifullah, I., & Bisri, H. (2024). Pengaruh penggunaan media pembelajaran Powerpoint interaktif terhadap minat belajar matematika siswa kelas VII madrasah tsanawiyah. *Asas Wa Tandhim: Jurnal Hukum, Pendidikan dan Sosial Keagamaan, 3*(2), 87-98. https://doi.org/10.47200/awtjhpsa.v3i2.2173

Hidayah, W. G., & Amelia, S. (2023). Efektivitas pembelajaran persamaan garis lurus dengan media video animasi dan LKPD siswa kelas VIII. *Jurnal Fibonaci,* 4(1), 39–46. https://doi.org/10.24114/jfi.v4i1.45177

Hikmah, R., & Nengsih, R. (2021). Etnomatematika: Persamaan garis lurus dengan media Geogebra. *Jurnal Derivat: Jurnal Matematika dan Pendidikan Matematika, 8*(2), 88-97. https://doi.org/10.31316/j.derivat.v8i2.1972

Husnaidah, M., Hrp, M. S., & Sofiyah, K. (2024). Konsep dasar matematika fondasi untuk berpikir logis. *Jurnal Ilmiah Multidisiplin Terpadu*, 8(12), 41–47.

Izzati, N., Wahyuni, N., & Irawan, B. (2023). Development of an interactive PowerPoint to instill a deeper understanding of polyhedron concepts in mathematics class. *Alifmatika: Jurnal Pendidikan dan Pembelajaran Matematika*, 5(1), 95-109. https://doi.org/10.35316/alifmatika.2023.v5i1.95-109

Kurniawan, E., & Sarjana, K. (2025). Pengaruh penggunaan media Powerpoint intetaktif dalam pembelajaran matematika terhadap prestasi belajar siswa kelas VIII SMPN 1 Gunungsari tahun ajaran 2024/2025. *Mandalika Mathematics and Educations Journal*, *7*(1), 66-76. http://dx.doi.org/10.29303/jm.v7i1.8708

Lumbantobing, S. S. (2023). Penerapan modul elektronik berbantuan Sigil untuk meningkatkan pemahaman konsep siswa pada materi kesetimbangan benda tegar. *Jurnal Penelitian Pembelajaran Fisika*, 14(2), 222-230. https://doi.org/10.26877/jp2f.v14i2.16946

Muhammad, H., Lusita, I. P., Yumeriza, I., Malti, K. P., Ningrum, M. F., Zorin, S., & Azima, N. F. (2025). Efektivitas penggunaan Media interaktif dalam pembelajaran matematika di sekolah dasar. *Bilangan: Jurnal Ilmiah Matematika, Kebumian dan Angkasa,* 3(2), 135-147. https://doi.org/10.62383/bilangan.v3i2.474

Muliyana, D., Roza, Y., & Armis, A. (2022). Pengembangan media pembelajaran interaktif menggunakan Powerpoint-Geogebra materi bangun ruang sisi datar kelas VIII SMP/MTs. *Jurnal Cendekia : Jurnal Pendidikan Matematika, 6*(1), 459-471. https://doi.org/10.31004/cendekia.v6i1.1038

Mutmainnah, N., Adrias, A., & Zulkarnaini, A. P. (2025). Implementasi pendekatan deep learning terhadap pembelajaran matematika di sekolah dasar. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *10*(1), 848-871. https://doi.org/10.23969/jp.v10i01.23781

Nabila, A., Aziz, A., & Suprapto, R. (2025). Systematic literature review: Pengaruh media pembelajaran digital terhadap pemahaman konsep matematis. *EDUSAINTEK: Jurnal Pendidikan, Sains dan Teknologi, 12*(2), 1079-1100. https://doi.org/10.47668/edusaintek.v12i2.1724

Nadawina, N., Jaya, A., Ramadhanti, D., Imronudin, I., Fatchiatuzahro, F., Halim, A., & Jati, G. P. R. S. (2025). *Penerapan Pembelajaran Deep Learning dalam Pendidikan di Indonesia*. Star Digital Publishing.

Ndani, Y. E., & Erita, S. (2023). Describe the understanding of mathematical concepts in class VII junior high school students regarding objective questions. *Didaktika: Jurnal Kependidikan*, 17(2), 64-72. https://doi.org/10.30863/didaktika.v17i2.5751

Nurhayati, S. A., Sunaengsih, C., & Isrok'atun, I. A. (2025). Pengaruh media video animasi terhadap pemahaman konsep matematis siswa kelas V sekolah dasar pada materi bangun ruang. *Al-Madrasah: Jurnal Ilmiah Pendidikan Madrasah Ibtidaiyah*, 9(1), 325-337. http://dx.doi.org/10.35931/am.v9i1.4316

Putri, A. E. (2024). Penggunaan media pembelajaran berbasis digital dalam pembelajaran sejarah untuk meningkatkan minat belajar peserta didik. *Jurnal Ilmiah Mahasiswa Pendidikan Sejarah*, 9(2), 533-540. https://doi.org/10.24815/jimps.v9i2.30523

Rahmansyah, B., & Warli, W. (2024). Studi komparasi penggunaan multimedia PowerPoint dan video animasi dalam meningkatkan pemahaman konsep bilangan bulat pada siswa SMP. *Teaching and Learning Journal of Mandalika (Teacher)*, 4(2), 97-102. https://doi.org/10.36312/teacher.v4i2.2129

Setyawati, E., Hidayati, I. S., & Hermawan, T. (2020). Pengaruh penggunaan multimedia interaktif terhadap pemahaman konsep dalam pembelajaran matematika di MTs Darul Ulum Muhammadiyah Galur. *Intersections: Jurnal Pendidikan Matematika dan Matematika*, *5*(2), 26-37. https://doi.org/10.47200/intersections.v5i2.553

Siregar, B. H., Mansyur, A., Lumongga, S., & Rahmadani, F. (2022). *Teori & praktis multimedia pembelajaran interaktif*. UMSU Press.

Siregar, B. H., Mansyur, A., & Yusoff, N. S. M. (2023). Innovation in the development of an electronic practicum book of IT-based learning media oriented to the team-based project. *Mosharafa: Jurnal Pendidikan Matematika*, *12*(2), 243-254. https://doi.org/10.31980/mosharafa.v12i2.780

Siregar, B. H., Panjaitan, A., Hasratuddin, H., Kairuddin, K., Mulyono, M., & Rahman, A. A. (2024). Digital media innovation based on multimedia cognitive and constructivist theory in a cultural context: Encouraging students' higher order thinking skills. *JTAM (Jurnal Teori dan Aplikasi Matematika„ 8*(1), 269-284. https://doi.org/10.31764/jtam.v8i1.16800

Sitompul, M. E., Manik, S., Pembayun, A., & Ayu, R. T. (2024). Pengaruh penggunaan media pembelajaran berbasis video animasi terhadap hasil belajar dan respon siswa kelas VII dalam proses pembelajaran matematika. *Jurnal Pustaka Cendekia Pendidikan*, 2(1), 1-5. https://doi.org/10.70292/jpcp.v2i1.67

Suhra, S., Masrura, S. I., & Tadjuddin, N. F. (2023). Pengaruh penggunaan video animasi pembelajaran matematika terhadap pemahaman matematika siswa kelas VIII SP Negeri 2 Majene. *AL JABAR: Jurnal Pendidikan dan Pembelajaran Matematika*, 2(1), 32-41. https://doi.org/10.46773/aljabar.v2i1.557

Susanti, L., Handriyantini, E., & Hamzah, A. (2023). *Guru kreatif inovatif era merdeka belajar*. Yogyakarta: Penerbit Andi.

Tarisa, & Manan, N. A. (2024). Pengaruh model pembelajaran kooperatif tipe make a match berbantuan media PowerPoint interaktif terhadap kemampuan pemahaman konsep pada pelajaran matematika. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, 9(3), 247-259. https://doi.org/10.23969/jp.v9i3.16999

Ziatdinov, R., & Valles Jr, J. R. (2022). Synthesis of modeling, visualization, and programming in GeoGebra as an effective approach for teaching and learning STEM topics. *Mathematics*, 10(3), 398. https://doi.org/10.48550/arXiv.2202.01415

Ziliwu, S. H., Sarumaha, R., & Harefa, D. (2022). Analisis kemampuan koneksi matematika pada materi transformasi siswa kelas XI SMK Negeri 1 Lahusa tahun pembelajaran 2020/2021. *Afore: Jurnal Pendidikan Matematika*, *1*(1), 15-25. https://doi.org/10.57094/afore.v1i1.433

Zulmaulida, R., Saputra, E., Munir, M., Zanthy, L. S., Wahnyuni, M., Irham, M., & Akmal, N. (2021). *Problematika pembelajaran matematika*. Yayasan Penerbit Muhammad Zaini.