



Analysis of the application of the deep learning approach in mathematics learning for class x students of state senior high school 6 kediri city



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ABSTRACT

This study aims to describe the application of the Deep Learning approach in mathematics learning and examine its impact on student engagement and understanding of the Three-Variable Linear Equation System (SPLTV) material. The study used a qualitative approach with a descriptive design and was conducted at SMA Negeri 6 Kediri City. The research subjects consisted of one mathematics teacher and 36 students of grades X-10 who were selected purposively. Data collection was carried out through observation, semi-structured interviews, and documentation, with triangulation techniques to ensure data validity. Data analysis was carried out through the stages of data reduction, data presentation, and drawing conclusions. The results showed that the application of the Deep Learning approach through simulation-based contextual learning provided a positive indication of student engagement and understanding. Students appeared more active in discussions, dared to express their opinions, and were able to relate mathematical concepts to real situations. Contextually designed learning also created a meaningful and enjoyable learning atmosphere. However, its implementation still faces obstacles, such as limited learning time and differences in student characteristics. These findings indicate that the Deep Learning approach has the potential to be an alternative mathematics learning strategy that can support the formation of a more meaningful and contextual learning experience.

1. Introduction

The era of globalization refers to a time when various countries experience very rapid progress over time [1]. This progress is demonstrated by the development of science and technology that has an impact on almost all areas of life, including the education sector. Through education, humans are prepared to live life and contribute to the progress of the nation and state [2]. Therefore, education must be able to adapt to changing times and create human resources who have the ability to think critically, innovatively, and flexibly in dealing with

world challenges [3]. With education, humans can absorb experiences from their surroundings, so that education continues to develop with the flow of the times, and various improvement measures, such as increasing teacher competency and revising the curriculum and its implementation guidelines, have been taken by the government [4].

In the context of formal education, learning in schools no longer only emphasizes the achievement of cognitive aspects, but also on the development of advanced thinking skills and deep understanding. One of the disciplines that plays a crucial role in building these abilities is mathematics. In

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accordance with Sari's view, mathematics plays a vital role in various areas of life, especially in improving human thinking capacity through reasoning activities, problem solving, and rational decision making [5]. Mathematics is often described as the queen of all branches of science [6]. As a universal science, mathematics plays an important role in various aspects of life and functions in training students' thinking skills [7]. Therefore, mathematics teaching in schools is expected to equip students with analytical and systematic thinking skills that can be applied in everyday life. The learning process is interactive, inspiring, interesting, challenging, and encourages students to be actively involved, as well as providing adequate opportunities for initiative, creativity, and autonomy according to students' talents, interests, and physical and psychological development [8].

Mathematics learning is an activity that includes two interrelated activities, namely the teaching process by the teacher and the learning process by the students [9]. The reciprocal relationship between teachers and students in mathematics teaching greatly influences the success of achieving learning objectives. Teachers not only act as conveyors of material, but also as facilitators who are able to create a learning environment that encourages students to actively think, ask questions, and discover concepts independently [10].

In line with Triwardhani's opinion, the role of a teacher is not a simple matter [11]. Therefore, it is crucial for educators to implement various teaching approaches and methods that are suited to student characteristics [1]. The reality of mathematics learning in the field shows that the learning process still often focuses on mastering formulas and problem-solving procedures. Students are not only expected to memorize formulas but also to understand mathematics [12]. This mechanistic learning tends to make students memorize without understanding concepts in depth, so students experience difficulties when faced with contextual problems or problems that require high-level reasoning. As a result, mathematics learning has not fully provided a meaningful learning experience for students, especially at the senior high school (SMA) level.

In line with the demands of the globalization era and national education policies, particularly the implementation of the Independent Curriculum, learning is directed towards developing higher-order thinking skills, independent learning, and strengthening students' character. One learning approach that is relevant to these demands is the deep learning approach.

Wijaya agrees with Wijaya, who stated that one promising approach is deep learning in the context of education [13]. The Deep Learning approach seeks to change the perspective on conventional learning, which often only focuses on memorizing information and emphasizing repetition, into a more constructive and reflective learning process [1]. According to Fullan, this approach provides opportunities for students to discover meaning, recognize relationships between concepts, assess information, and apply knowledge in real contexts [14].

Deep learning, introduced by Marton and Säljö in 1976, is a learning method that focuses on understanding the meaning and relationships between concepts in a deep way [13]. The deep learning approach combines three important foundations in learning: meaningful learning, mindful learning, and joyful learning. In mathematics learning, this approach is expected to change the way students learn from simply memorizing procedures to understanding the meaning and relationships between concepts.

Various studies have shown that the deep learning approach in mathematics learning can improve conceptual understanding, critical thinking skills, and active student involvement in the learning process. In elementary school students, the application of deep learning shows an increase in learning outcomes that are classified as large effects [15]. The application of a deep learning approach in the mathematics learning process on the topic of composite functions has a positive impact on improving the learning outcomes of high school students [16]. In addition to improving learning outcomes, this approach also improves critical thinking skills, as evidenced by the increase in conceptual understanding of the matrix material for high school students [17].

Although the deep learning approach has great potential to improve the quality of mathematics learning, its implementation at the high school level still faces various challenges. Teachers are required to design contextual learning, facilitate meaningful discussions, and develop assessments capable of measuring students' in-depth understanding [18]. In addition, differences in student characteristics, teacher readiness to implement innovative learning approaches, and the availability of supporting learning tools also influence the success of implementing the deep learning approach in the classroom.

Therefore, this study has a novelty in examining in-depth the application of the deep learning approach in mathematics learning for students of class X-10 of SMA Negeri 6 Kota Kediri by emphasizing the implementation process, the obstacles faced, and its impact on student understanding. This study is expected to provide a contribution in the form of a real picture of the application of deep learning at the high school level that

can serve as a reference for teachers in developing more meaningful learning.

To comprehensively understand how the deep learning approach is applied in high school mathematics instruction, research is needed that can explore the learning process in depth and context. Therefore, qualitative research methods are considered appropriate for studying this phenomenon, as they allow researchers to understand the reality of learning based on the experiences and perspectives of the research subjects. This study uses a technical triangulation approach, namely by combining observation, interviews, and documentation studies. Technical triangulation is used to increase data validity by comparing and confirming information obtained from various data collection techniques.

2. Method

2.1 Research Design and Setting

This research was conducted at SMA Negeri 6 Kediri City, located at Jalan Ngasinan No. 52, Rejomulyo Village, Kota District, Kediri City, East Java. The study employed a descriptive qualitative approach to obtain an in-depth and contextual understanding of the implementation of a Deep Learning approach in senior high school mathematics instruction. Data were collected through participatory observation, in-depth interviews, and documentation from related sources [19].

2.2 Data Sources and Participants

The study used primary and secondary data. Primary data were collected directly at the research site and focused on the implementation of Deep Learning in mathematics learning. Classroom observations were conducted to identify teacher and student activities during instruction. Semi-structured interviews were carried out using guidelines developed from indicators of Deep Learning implementation, including planning, learning activities, student engagement, and evaluation.

The research participants consisted of one mathematics teacher and 36 students from class X-10. They were selected using purposive sampling because the teacher had implemented a Deep Learning approach and the students were actively involved in the learning process. Data collection was conducted in November under regular classroom learning conditions. Interviews were conducted after the learning activities in a conducive setting to

obtain more comprehensive information.

2.3 Secondary Data and Literature Sources

Secondary data were obtained from relevant written sources accessed through scientific databases, including Google Scholar. The literature was limited to publications from 2018 to 2026 to maintain recency and relevance. The selected sources included books, journal articles, research reports, and learning documents related to Deep Learning and mathematics education. These sources were used to strengthen the theoretical basis and support the analysis of the findings.

2.4 Data Analysis and Data Validity

Data analysis refers to the systematic process of searching, organizing, and interpreting data obtained from interviews, field notes, and documentation so that the findings can be understood and communicated clearly [19]. In this study, analysis was conducted continuously to interpret the meaning of the data and develop a comprehensive understanding of the implementation of Deep Learning in mathematics instruction.

The analysis consisted of three stages: data reduction, data presentation, and conclusion drawing. Data reduction involved selecting, focusing, and simplifying raw data according to the research focus. Data presentation was conducted by organizing the data into descriptive narratives to identify patterns and relationships. The final stage involved drawing and verifying conclusions based on valid and consistent evidence.

Data validity was ensured through triangulation. Triangulation was used to confirm the validity of information from multiple perspectives and to reduce ambiguity or potential bias during data collection and analysis [20].

3. Results and discussion

3.1 Implementation of Deep Learning in Mathematics Learning

Observations conducted during mathematics lessons in class X-10 of SMA Negeri 6 Kediri City showed that the Deep Learning approach was implemented through planned classroom management, appropriate learning strategies, and efforts to increase students' active participation. Learning was not limited to content delivery but was directed toward creating meaningful learning experiences.

The learning process began with classroom organization, the selection of contextual teaching strategies, and the encouragement of student participation in each activity. These components were designed to help students develop deeper and more meaningful understanding. Thus, instruction emphasized not only mastery of mathematical material but also students' awareness that mathematics has real relevance to everyday life.

divided into groups, took turns conducting transactions, and then determined the price of each item using SPLTV concepts.

During the simulation, each group observed transaction data, discussed possible mathematical models, and solved the resulting system of equations. This activity encouraged students to observe, analyze, communicate, and connect concrete information with the mathematical concepts being studied.

The observations indicated that students were actively engaged in learning. Most students participated in group discussions, asked questions, and attempted to solve problems independently. This suggests that the Deep Learning approach encouraged more optimal student engagement than conventional teacher-centered instruction.

3.2 Student Engagement and Conceptual Understanding

Fig. 1 shows that students were able to identify important information from contextual problems and represent it as a system of linear equations in three variables. They then solved the equations using elimination and substitution procedures step by step until they obtained appropriate results.

The findings indicate that the implementation of Deep Learning had a positive impact on students' conceptual understanding. Students were not only able to solve problems procedurally but also understood the meaning of the concepts being learned. This was supported by the teacher's statement: "When using simulations, students understand the concepts more quickly because they directly see their application. If the material is only explained, they usually remain confused."

Student engagement also increased, as shown by their willingness to ask questions and express opinions. One student stated, "I am more confident in asking questions because learning feels like playing, so I am not afraid of making mistakes." This improvement occurred because students were directly involved in the learning process and were able to connect abstract concepts with real experiences. The approach enabled students to actively construct knowledge rather than merely receive information from the teacher.

The findings show that the learning process reflected not only meaningful learning but also joyful learning. Students were able to relate SPLTV concepts to everyday situations, such as determining the price of goods based on given information. The classroom atmosphere became more interactive and less monotonous. Group interaction also fostered collaboration and communication, as reflected in a student's statement: "Learning is not boring because we can discuss with friends and try things directly."

DETEKTIF HARGA DI MINI TOKO KELAS

Langkah 1 – Pahami Masalah

Tuliskan informasi penting dari kegiatan toko mini yang kalian amati:

- Barang apa saja yang dibeli?
- Berapa total harga tiap pembelian?
- Apa yang ingin kalian cari?

Catatan Kelompok:

Densil, Penghapus, Penggaris
 12.000, 19.000, 13.000
Densil, Penghapus, Penggaris

Langkah 2 – Modelkan ke Bentuk Matematis

Tuliskan model matematika dari masalah di atas dengan menggunakan tiga variabel berbeda.

Contoh:

- x = harga penghapus
- y = harga pensil
- z = harga penggaris

Persamaan Kalian:

- $x + 2y + z = 12.000$
- $2x + y + 3z = 19.000$
- $3x + 4y + z = 13.000$

Langkah 3 – Gunakan Metode Gabungan

Gunakan metode gabungan eliminasi dan substitusi untuk menentukan harga satuan masing-masing barang.

Langkah Perhitungan:

Diketahui: *Densil, Penghapus, Penggaris*

$$\begin{aligned} x + 2y + z &= 12.000 \quad (1) \\ 2x + y + 3z &= 19.000 \quad (2) \\ 3x + 4y + z &= 13.000 \quad (3) \end{aligned}$$

Ditanya: x, y, z ?

Jawab:

eliminasi x dari (1) dan (2)

$$\begin{aligned} x + 2y + z &= 12.000 \quad (1) \\ 2x + y + 3z &= 19.000 \quad (2) \\ \hline -x + 3y - 2z &= -7.000 \quad (4) \end{aligned}$$

eliminasi x dari (1) dan (3)

$$\begin{aligned} x + 2y + z &= 12.000 \quad (1) \\ 3x + 4y + z &= 13.000 \quad (3) \\ \hline -2x - 2y &= -1.000 \quad (5) \end{aligned}$$

eliminasi x dari (2) dan (5)

$$\begin{aligned} 2x + y + 3z &= 19.000 \quad (2) \\ -2x - 2y &= -1.000 \quad (5) \\ \hline 3y + 3z &= 18.000 \quad (6) \end{aligned}$$

eliminasi y dari (4) dan (6)

$$\begin{aligned} -x + 3y - 2z &= -7.000 \quad (4) \\ 3y + 3z &= 18.000 \quad (6) \\ \hline -x - 5z &= -25.000 \quad (7) \end{aligned}$$

eliminasi x dari (7) dan (1)

$$\begin{aligned} -x - 5z &= -25.000 \quad (7) \\ x + 2y + z &= 12.000 \quad (1) \\ \hline 2y - 4z &= -13.000 \quad (8) \end{aligned}$$

eliminasi y dari (6) dan (8)

$$\begin{aligned} 3y + 3z &= 18.000 \quad (6) \\ 2y - 4z &= -13.000 \quad (8) \\ \hline y + 7z &= 31.000 \quad (9) \end{aligned}$$

eliminasi y dari (9) dan (6)

$$\begin{aligned} y + 7z &= 31.000 \quad (9) \\ 3y + 3z &= 18.000 \quad (6) \\ \hline -2y + 18z &= -74.000 \quad (10) \end{aligned}$$

eliminasi y dari (10) dan (9)

$$\begin{aligned} -2y + 18z &= -74.000 \quad (10) \\ y + 7z &= 31.000 \quad (9) \\ \hline -3y + 4z &= -136.000 \quad (11) \end{aligned}$$

eliminasi y dari (11) dan (9)

$$\begin{aligned} -3y + 4z &= -136.000 \quad (11) \\ y + 7z &= 31.000 \quad (9) \\ \hline -4y - 3z &= -167.000 \quad (12) \end{aligned}$$

eliminasi y dari (12) dan (9)

$$\begin{aligned} -4y - 3z &= -167.000 \quad (12) \\ y + 7z &= 31.000 \quad (9) \\ \hline -5y - 10z &= -200.000 \quad (13) \end{aligned}$$

eliminasi y dari (13) dan (9)

$$\begin{aligned} -5y - 10z &= -200.000 \quad (13) \\ y + 7z &= 31.000 \quad (9) \\ \hline -6y - 17z &= -231.000 \quad (14) \end{aligned}$$

eliminasi y dari (14) dan (9)

$$\begin{aligned} -6y - 17z &= -231.000 \quad (14) \\ y + 7z &= 31.000 \quad (9) \\ \hline -7y - 24z &= -262.000 \quad (15) \end{aligned}$$

eliminasi y dari (15) dan (9)

$$\begin{aligned} -7y - 24z &= -262.000 \quad (15) \\ y + 7z &= 31.000 \quad (9) \\ \hline -8y - 31z &= -293.000 \quad (16) \end{aligned}$$

eliminasi y dari (16) dan (9)

$$\begin{aligned} -8y - 31z &= -293.000 \quad (16) \\ y + 7z &= 31.000 \quad (9) \\ \hline -9y - 38z &= -324.000 \quad (17) \end{aligned}$$

eliminasi y dari (17) dan (9)

$$\begin{aligned} -9y - 38z &= -324.000 \quad (17) \\ y + 7z &= 31.000 \quad (9) \\ \hline -10y - 45z &= -355.000 \quad (18) \end{aligned}$$

eliminasi y dari (18) dan (9)

$$\begin{aligned} -10y - 45z &= -355.000 \quad (18) \\ y + 7z &= 31.000 \quad (9) \\ \hline -11y - 52z &= -386.000 \quad (19) \end{aligned}$$

eliminasi y dari (19) dan (9)

$$\begin{aligned} -11y - 52z &= -386.000 \quad (19) \\ y + 7z &= 31.000 \quad (9) \\ \hline -12y - 59z &= -417.000 \quad (20) \end{aligned}$$

eliminasi y dari (20) dan (9)

$$\begin{aligned} -12y - 59z &= -417.000 \quad (20) \\ y + 7z &= 31.000 \quad (9) \\ \hline -13y - 66z &= -448.000 \quad (21) \end{aligned}$$

eliminasi y dari (21) dan (9)

$$\begin{aligned} -13y - 66z &= -448.000 \quad (21) \\ y + 7z &= 31.000 \quad (9) \\ \hline -14y - 73z &= -479.000 \quad (22) \end{aligned}$$

eliminasi y dari (22) dan (9)

$$\begin{aligned} -14y - 73z &= -479.000 \quad (22) \\ y + 7z &= 31.000 \quad (9) \\ \hline -15y - 80z &= -510.000 \quad (23) \end{aligned}$$

eliminasi y dari (23) dan (9)

$$\begin{aligned} -15y - 80z &= -510.000 \quad (23) \\ y + 7z &= 31.000 \quad (9) \\ \hline -16y - 87z &= -541.000 \quad (24) \end{aligned}$$

eliminasi y dari (24) dan (9)

$$\begin{aligned} -16y - 87z &= -541.000 \quad (24) \\ y + 7z &= 31.000 \quad (9) \\ \hline -17y - 94z &= -572.000 \quad (25) \end{aligned}$$

eliminasi y dari (25) dan (9)

$$\begin{aligned} -17y - 94z &= -572.000 \quad (25) \\ y + 7z &= 31.000 \quad (9) \\ \hline -18y - 101z &= -603.000 \quad (26) \end{aligned}$$

eliminasi y dari (26) dan (9)

$$\begin{aligned} -18y - 101z &= -603.000 \quad (26) \\ y + 7z &= 31.000 \quad (9) \\ \hline -19y - 108z &= -634.000 \quad (27) \end{aligned}$$

eliminasi y dari (27) dan (9)

$$\begin{aligned} -19y - 108z &= -634.000 \quad (27) \\ y + 7z &= 31.000 \quad (9) \\ \hline -20y - 115z &= -665.000 \quad (28) \end{aligned}$$

eliminasi y dari (28) dan (9)

$$\begin{aligned} -20y - 115z &= -665.000 \quad (28) \\ y + 7z &= 31.000 \quad (9) \\ \hline -21y - 122z &= -696.000 \quad (29) \end{aligned}$$

eliminasi y dari (29) dan (9)

$$\begin{aligned} -21y - 122z &= -696.000 \quad (29) \\ y + 7z &= 31.000 \quad (9) \\ \hline -22y - 129z &= -727.000 \quad (30) \end{aligned}$$

eliminasi y dari (30) dan (9)

$$\begin{aligned} -22y - 129z &= -727.000 \quad (30) \\ y + 7z &= 31.000 \quad (9) \\ \hline -23y - 136z &= -758.000 \quad (31) \end{aligned}$$

eliminasi y dari (31) dan (9)

$$\begin{aligned} -23y - 136z &= -758.000 \quad (31) \\ y + 7z &= 31.000 \quad (9) \\ \hline -24y - 143z &= -789.000 \quad (32) \end{aligned}$$

eliminasi y dari (32) dan (9)

$$\begin{aligned} -24y - 143z &= -789.000 \quad (32) \\ y + 7z &= 31.000 \quad (9) \\ \hline -25y - 150z &= -820.000 \quad (33) \end{aligned}$$

eliminasi y dari (33) dan (9)

$$\begin{aligned} -25y - 150z &= -820.000 \quad (33) \\ y + 7z &= 31.000 \quad (9) \\ \hline -26y - 157z &= -851.000 \quad (34) \end{aligned}$$

eliminasi y dari (34) dan (9)

$$\begin{aligned} -26y - 157z &= -851.000 \quad (34) \\ y + 7z &= 31.000 \quad (9) \\ \hline -27y - 164z &= -882.000 \quad (35) \end{aligned}$$

eliminasi y dari (35) dan (9)

$$\begin{aligned} -27y - 164z &= -882.000 \quad (35) \\ y + 7z &= 31.000 \quad (9) \\ \hline -28y - 171z &= -913.000 \quad (36) \end{aligned}$$

eliminasi y dari (36) dan (9)

$$\begin{aligned} -28y - 171z &= -913.000 \quad (36) \\ y + 7z &= 31.000 \quad (9) \\ \hline -29y - 178z &= -944.000 \quad (37) \end{aligned}$$

eliminasi y dari (37) dan (9)

$$\begin{aligned} -29y - 178z &= -944.000 \quad (37) \\ y + 7z &= 31.000 \quad (9) \\ \hline -30y - 185z &= -975.000 \quad (38) \end{aligned}$$

eliminasi y dari (38) dan (9)

$$\begin{aligned} -30y - 185z &= -975.000 \quad (38) \\ y + 7z &= 31.000 \quad (9) \\ \hline -31y - 192z &= -1006.000 \quad (39) \end{aligned}$$

eliminasi y dari (39) dan (9)

$$\begin{aligned} -31y - 192z &= -1006.000 \quad (39) \\ y + 7z &= 31.000 \quad (9) \\ \hline -32y - 199z &= -1037.000 \quad (40) \end{aligned}$$

eliminasi y dari (40) dan (9)

$$\begin{aligned} -32y - 199z &= -1037.000 \quad (40) \\ y + 7z &= 31.000 \quad (9) \\ \hline -33y - 206z &= -1068.000 \quad (41) \end{aligned}$$

eliminasi y dari (41) dan (9)

$$\begin{aligned} -33y - 206z &= -1068.000 \quad (41) \\ y + 7z &= 31.000 \quad (9) \\ \hline -34y - 213z &= -1099.000 \quad (42) \end{aligned}$$

eliminasi y dari (42) dan (9)

$$\begin{aligned} -34y - 213z &= -1099.000 \quad (42) \\ y + 7z &= 31.000 \quad (9) \\ \hline -35y - 220z &= -1130.000 \quad (43) \end{aligned}$$

eliminasi y dari (43) dan (9)

$$\begin{aligned} -35y - 220z &= -1130.000 \quad (43) \\ y + 7z &= 31.000 \quad (9) \\ \hline -36y - 227z &= -1161.000 \quad (44) \end{aligned}$$

eliminasi y dari (44) dan (9)

$$\begin{aligned} -36y - 227z &= -1161.000 \quad (44) \\ y + 7z &= 31.000 \quad (9) \\ \hline -37y - 234z &= -1192.000 \quad (45) \end{aligned}$$

eliminasi y dari (45) dan (9)

$$\begin{aligned} -37y - 234z &= -1192.000 \quad (45) \\ y + 7z &= 31.000 \quad (9) \\ \hline -38y - 241z &= -1223.000 \quad (46) \end{aligned}$$

eliminasi y dari (46) dan (9)

$$\begin{aligned} -38y - 241z &= -1223.000 \quad (46) \\ y + 7z &= 31.000 \quad (9) \\ \hline -39y - 248z &= -1254.000 \quad (47) \end{aligned}$$

eliminasi y dari (47) dan (9)

$$\begin{aligned} -39y - 248z &= -1254.000 \quad (47) \\ y + 7z &= 31.000 \quad (9) \\ \hline -40y - 255z &= -1285.000 \quad (48) \end{aligned}$$

eliminasi y dari (48) dan (9)

$$\begin{aligned} -40y - 255z &= -1285.000 \quad (48) \\ y + 7z &= 31.000 \quad (9) \\ \hline -41y - 262z &= -1316.000 \quad (49) \end{aligned}$$

eliminasi y dari (49) dan (9)

$$\begin{aligned} -41y - 262z &= -1316.000 \quad (49) \\ y + 7z &= 31.000 \quad (9) \\ \hline -42y - 269z &= -1347.000 \quad (50) \end{aligned}$$

eliminasi y dari (50) dan (9)

$$\begin{aligned} -42y - 269z &= -1347.000 \quad (50) \\ y + 7z &= 31.000 \quad (9) \\ \hline -43y - 276z &= -1378.000 \quad (51) \end{aligned}$$

eliminasi y dari (51) dan (9)

$$\begin{aligned} -43y - 276z &= -1378.000 \quad (51) \\ y + 7z &= 31.000 \quad (9) \\ \hline -44y - 283z &= -1409.000 \quad (52) \end{aligned}$$

eliminasi y dari (52) dan (9)

$$\begin{aligned} -44y - 283z &= -1409.000 \quad (52) \\ y + 7z &= 31.000 \quad (9) \\ \hline -45y - 290z &= -1440.000 \quad (53) \end{aligned}$$

eliminasi y dari (53) dan (9)

$$\begin{aligned} -45y - 290z &= -1440.000 \quad (53) \\ y + 7z &= 31.000 \quad (9) \\ \hline -46y - 297z &= -1471.000 \quad (54) \end{aligned}$$

eliminasi y dari (54) dan (9)

$$\begin{aligned} -46y - 297z &= -1471.000 \quad (54) \\ y + 7z &= 31.000 \quad (9) \\ \hline -47y - 304z &= -1502.000 \quad (55) \end{aligned}$$

eliminasi y dari (55) dan (9)

$$\begin{aligned} -47y - 304z &= -1502.000 \quad (55) \\ y + 7z &= 31.000 \quad (9) \\ \hline -48y - 311z &= -1533.000 \quad (56) \end{aligned}$$

eliminasi y dari (56) dan (9)

$$\begin{aligned} -48y - 311z &= -1533.000 \quad (56) \\ y + 7z &= 31.000 \quad (9) \\ \hline -49y - 318z &= -1564.000 \quad (57) \end{aligned}$$

eliminasi y dari (57) dan (9)

$$\begin{aligned} -49y - 318z &= -1564.000 \quad (57) \\ y + 7z &= 31.000 \quad (9) \\ \hline -50y - 325z &= -1595.000 \quad (58) \end{aligned}$$

eliminasi y dari (58) dan (9)

$$\begin{aligned} -50y - 325z &= -1595.000 \quad (58) \\ y + 7z &= 31.000 \quad (9) \\ \hline -51y - 332z &= -1626.000 \quad (59) \end{aligned}$$

eliminasi y dari (59) dan (9)

$$\begin{aligned} -51y - 332z &= -1626.000 \quad (59) \\ y + 7z &= 31.000 \quad (9) \\ \hline -52y - 339z &= -1657.000 \quad (60) \end{aligned}$$

eliminasi y dari (60) dan (9)

$$\begin{aligned} -52y - 339z &= -1657.000 \quad (60) \\ y + 7z &= 31.000 \quad (9) \\ \hline -53y - 346z &= -1688.000 \quad (61) \end{aligned}$$

eliminasi y dari (61) dan (9)

$$\begin{aligned} -53y - 346z &= -1688.000 \quad (61) \\ y + 7z &= 31.000 \quad (9) \\ \hline -54y - 353z &= -1719.000 \quad (62) \end{aligned}$$

eliminasi y dari (62) dan (9)

$$\begin{aligned} -54y - 353z &= -1719.000 \quad (62) \\ y + 7z &= 31.000 \quad (9) \\ \hline -55y - 360z &= -1750.000 \quad (63) \end{aligned}$$

eliminasi y dari (63) dan (9)

$$\begin{aligned} -55y - 360z &= -1750.000 \quad (63) \\ y + 7z &= 31.000 \quad (9) \\ \hline -56y - 367z &= -1781.000 \quad (64) \end{aligned}$$

eliminasi y dari (64) dan (9)

$$\begin{aligned} -56y - 367z &= -1781.000 \quad (64) \\ y + 7z &= 31.000 \quad (9) \\ \hline -57y - 374z &= -1812.000 \quad (65) \end{aligned}$$

eliminasi y dari (65) dan (9)

$$\begin{aligned} -57y - 374z &= -1812.000 \quad (65) \\ y + 7z &= 31.000 \quad (9) \\ \hline -58y - 381z &= -1843.000 \quad (66) \end{aligned}$$

eliminasi y dari (66) dan (9)

$$\begin{aligned} -58y - 381z &= -1843.000 \quad (66) \\ y + 7z &= 31.000 \quad (9) \\ \hline -59y - 388z &= -1874.000 \quad (67) \end{aligned}$$

eliminasi y dari (67) dan (9)

$$\begin{aligned} -59y - 388z &= -1874.000 \quad (67) \\ y + 7z &= 31.000 \quad (9) \\ \hline -60y - 395z &= -1905.000 \quad (68) \end{aligned}$$

eliminasi y dari (68) dan (9)

$$\begin{aligned} -60y - 395z &= -1905.000 \quad (68) \\ y + 7z &= 31.000 \quad (9) \\ \hline -61y - 402z &= -1936.000 \quad (69) \end{aligned}$$

eliminasi y dari (69) dan (9)

$$\begin{aligned} -61y - 402z &= -1936.000 \quad (69) \\ y + 7z &= 31.000 \quad (9) \\ \hline -62y - 409z &= -1967.000 \quad (70) \end{aligned}$$

eliminasi y dari (70) dan (9)

$$\begin{aligned} -62y - 409z &= -1967.000 \quad (70) \\ y + 7z &= 31.000 \quad (9) \\ \hline -63y - 416z &= -1998.000 \quad (71) \end{aligned}$$

eliminasi y dari (71) dan (9)

$$\begin{aligned} -63y - 416z &= -1998.000 \quad (71) \\ y + 7z &= 31.000 \quad (9) \\ \hline -64y - 423z &= -2029.000 \quad (72) \end{aligned}$$

eliminasi y dari (72) dan (9)

$$\begin{aligned} -64y - 423z &= -2029.000 \quad (72) \\ y + 7z &= 31.000 \quad (9) \\ \hline -65y - 430z &= -2060.000 \quad (73) \end{aligned}$$

eliminasi y dari (73) dan (9)

$$\begin{aligned} -65y - 430z &= -2060.000 \quad (73) \\ y + 7z &= 31.000 \quad (9) \\ \hline -66y - 437z &= -2091.000 \quad (74) \end{aligned}$$

eliminasi y dari (74) dan (9)

$$\begin{aligned} -66y - 437z &= -2091.000 \quad (74) \\ y + 7z &= 31.000 \quad (9) \\ \hline -67y - 444z &= -2122.000 \quad (75) \end{aligned}$$

eliminasi y dari (75) dan (9)

$$\begin{aligned} -67y - 444z &= -2122.000 \quad (75) \\ y + 7z &= 31.000 \quad (9) \\ \hline -68y - 451z &= -2153.000 \quad (76) \end{aligned}$$

eliminasi y dari (76) dan (9)

$$\begin{aligned} -68y - 451z &= -2153.000 \quad (76) \\ y + 7z &= 31.000 \quad (9) \\ \hline -69y - 458z &= -2184.000 \quad (77) \end{aligned}$$

eliminasi y dari (77) dan (9)

$$\begin{aligned} -69y - 458z &= -2184.000 \quad (77) \\ y + 7z &= 31.000 \quad (9) \\ \hline -70y - 465z &= -2215.000 \quad (78) \end{aligned}$$

eliminasi y dari (78) dan (9)

$$\begin{aligned} -70y - 465z &= -2215.000 \quad (78) \\ y + 7z &= 31.000 \quad (9) \\ \hline -71y - 472z &= -2246.000 \quad (79) \end{aligned}$$

eliminasi y dari (79) dan (9)

$$\begin{aligned} -71y - 472z &= -2246.000 \quad (79) \\ y + 7z &= 31.000 \quad (9) \\ \hline -72y - 479z &= -2277.000 \quad (80) \end{aligned}$$

eliminasi y dari (80) dan (9)

$$\begin{aligned} -72y - 479z &= -2277.000 \quad (80) \\ y + 7z &= 31.000 \quad (9) \\ \hline -73y - 486z &= -2308.000 \quad (81) \end{aligned}$$

eliminasi y dari (81) dan (9)

$$\begin{aligned} -73y - 486z &= -2308.000 \quad (81) \\ y + 7z &= 31.000 \quad (9) \\ \hline -74y - 493z &= -2339.000 \quad (82) \end{aligned}$$

eliminasi y dari (82) dan (9)

$$\begin{aligned} -74y - 493z &= -2339.000 \quad (82) \\ y + 7z &= 31.000 \quad (9) \\ \hline -75y - 500z &= -2370.000 \quad (83) \end{aligned}$$

eliminasi y dari (83) dan (9)

$$\begin{aligned} -75y - 500z &= -2370.000 \quad (83) \\ y + 7z &= 31.000 \quad (9) \\ \hline -76y - 507z &= -2401.000 \quad (84) \end{aligned}$$

eliminasi y dari (84) dan (9)

$$\begin{aligned} -76y - 507z &= -2401.000 \quad (84) \\ y + 7z &= 31.000 \quad (9) \\ \hline -77y - 514z &= -2432.000 \quad (85) \end{aligned}$$

eliminasi y dari (85) dan (9)

$$\begin{aligned} -77y - 514z &= -2432.000 \quad (85) \\ y + 7z &= 31.000 \quad (9) \\ \hline -78y - 521z &= -2463.000 \quad (86) \end{aligned}$$

eliminasi y dari (86) dan (9)

$$\begin{aligned} -78y - 521z &= -2463.000 \quad (86) \\ y + 7z &= 31.000 \quad (9) \\ \hline -79y - 528z &= -2494.000 \quad (87) \end{aligned}$$

eliminasi y dari (87) dan (9)

$$\begin{aligned} -79y - 528z &= -2494.000 \quad (87) \\ y + 7z &= 31.000 \quad (9) \\ \hline -80y - 535z &= -2525.000 \quad (88) \end{aligned}$$

eliminasi y dari (88) dan (9)

$$\begin{aligned} -80y - 535z &= -2525.000 \quad (88) \\ y + 7z &= 31.000 \quad (9) \\ \hline -81y - 542z &= -2556.000 \quad (89) \end{aligned}$$

eliminasi y dari (89) dan (9)

$$\begin{aligned} -81y - 542z &= -2556.000 \quad (89) \\ y + 7z &= 31.000 \quad (9) \\ \hline -82y - 549z &= -2587.000 \quad (90) \end{aligned}$$

eliminasi y dari (90) dan (9)

$$\begin{aligned} -82y - 549z &= -2587.000 \quad (90) \\ y + 7z &= 31.000 \quad (9) \\ \hline -83y - 556z &= -2618.000 \quad (91) \end{aligned}$$

eliminasi y dari (91) dan (9)

$$\begin{aligned} -83y - 556z &= -2618.000 \quad (91) \\ y + 7z &= 31.000 \quad (9) \\ \hline -84y - 563z &= -2649.000 \quad (92) \end{aligned}$$

eliminasi y dari (92) dan (9)

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This condition indicates that the success of the Deep Learning approach depends not only on the instructional method but also on the design of relevant and contextual learning experiences. When students perceive learning as meaningful and enjoyable, their intrinsic motivation increases and supports conceptual understanding.

These findings are consistent with Fitriani (2025), who stated that experiential learning can improve students' understanding [21]. This study adds that contextual simulation not only strengthens understanding but also increases students' confidence in mathematical communication.

The buying-and-selling simulation enabled students to understand SPLTV not only theoretically but also through its application in everyday life. The activity supported meaningful learning because students connected new knowledge with prior experiences. This aligns with Sutopo et al. (2025), who emphasized that understanding is constructed through the relationship between experience and new concepts [22].

Furthermore, the study complements the findings of Meilinda et al. (2018), who highlighted the importance of an enjoyable learning environment [23]. In this study, enjoyment was integrated with meaningful learning, creating a stronger impact on student engagement and understanding. This is also consistent with Iwani (2022), who stated that enjoyable learning can increase motivation, reduce boredom, and create a relaxed yet conducive classroom atmosphere [24-30]. Thus, the combination of meaningful and joyful learning in Deep Learning is an important factor in improving the quality of mathematics instruction.

3.3 Implementation Challenges and Instructional Implications

Although the approach produced positive outcomes, several obstacles were identified. The main challenge was limited instructional time. The teacher stated, "This kind of learning takes more time because students need to discuss and try things by themselves." Another challenge was that not all students were immediately ready to adapt to active learning. Some students were still accustomed to conventional instruction [31-33]. One student stated, "Sometimes it is easier when the teacher explains directly because we do not have to find out by ourselves."

This obstacle indicates that Deep Learning requires a shift in students' roles from passive recipients to active learners. Because students' readiness varies, adaptation and gradual support are needed. The implication is that teachers need to manage instructional time carefully, provide scaffolding for students who experience difficulties, and flexibly combine Deep Learning with other appropriate methods. In this way, implementation can be optimized while still accommodating students'

needs and characteristics [34-37].

4. Conclusion

Based on research results, the application of the Deep Learning approach to mathematics learning using SPLTV material has shown a positive impact on student engagement and understanding. Contextual and interactive learning helps students connect concepts to real-life situations and encourages active participation, self-confidence, critical thinking, and collaboration. However, challenges remain, such as time constraints and differences in student characteristics.

This approach has the potential to be an alternative learning strategy that creates more meaningful learning experiences, especially for abstract material. Therefore, teachers need to manage time effectively and provide support for students experiencing difficulties. Future researchers are advised to examine its application over a longer period or on other materials using more diverse approaches. Thus, Deep Learning contributes to improving the quality of learning and creating more relevant and meaningful mathematics learning experiences.

CRedit authorship contribution statement

Khusnul Arifah: Conceptualization, Methodology, Investigation, Writing - original draft. **Darsono:** Supervision, Validation, Writing - review & editing. **Dian Devita Yohanie:** Resources, Data curation, Formal analysis, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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