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The Influence of Deep Learning With Spedomatik Media on Enhancing Collaborative and Critical Thingking Skills of Elementary School Students

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A B S T R A C T

This study investigates the effect of applying Deep Learning assisted by Spedomatik Media on improving collaborative skills and critical thinking among elementary school students. The research employed a quasi-experimental design with a one-group pretest-posttest approach. The sample consisted of 25 second-grade students from SDN 1 Sumberagung. Data were collected using pretests, posttests, observational checklists, and collaboration skills questionnaires. The results showed significant improvements in both collaborative skills and critical thinking after the intervention. The classical learning completeness increased from 0% to 80%, indicating the effectiveness of Deep Learning in enhancing student engagement and collaboration. The regression analysis indicated that Deep Learning contributed significantly to the improvement of both skills, with a 49.9% increase in collaborative skills and a 60.4% increase in critical thinking skills. The Manova test further confirmed the simultaneous effect of Deep Learning on both skills. These findings suggest that the integration of Spedomatik Media into Deep Learning strategies fosters a more interactive and effective learning environment, thereby enhancing students' ability to collaborate and think critically. The study highlights the potential of this approach for future educational practices in elementary schools.

1. Introduction

The Education in Indonesia is currently undergoing a significant paradigm shift in response to the dynamic changes of the globalization era. The focus of 21st-century education has shifted from rote memorization to deep understanding, analysis, and knowledge-based problem solving (Hendrianty et al., 2024). Students are expected not only to master academic knowledge but also to develop global skills relevant for contemporary challenges (Soghomonyan & Karapetyan, 2023). According to

Fullan et al. (2018), six global competencies are essential for students: character, citizenship, collaboration, communication, creativity, and critical thinking. Redhana (2019) similarly emphasizes four core skills: critical thinking and problem-solving, creativity and innovation, collaboration, and communication. These frameworks highlight the importance of collaboration and critical thinking as fundamental competencies for modern learners.

Among these skills, collaboration and critical thinking are increasingly emphasized because they prepare students for complex global challenges (Muawiyah., 2023; Rahmawati et al., 2023; Sarifah & Nurita, 2023). Collaboration skills involve effective teamwork to achieve shared goals, while critical thinking entails logical, analytical, and reflective processing of information (Kemendikdasmen, 2025). Despite their importance, implementing learning that emphasizes these skills in elementary classrooms remains challenging. Nahar et al. (2022) note that low collaboration skills stem from teacher-centered learning and limited real-life context integration, while Sarwanto et al. (2021) attribute low critical thinking skills to lecture-based methods that restrict active and creative student involvement. Teacher-centered approaches often limit opportunities for students to develop higher-order thinking and creativity (Wijaya et al., 2025).

A practical example can be seen at SDN 1 Sumberagung, where students' collaboration and critical thinking in mathematics, particularly in Place Value lessons, remain low. Observations reveal that about 70% of students show minimal engagement in group interactions, relying on peers to complete tasks. Achievement data indicate that 75% of students score below the established standards, highlighting the need for innovative instructional strategies.To address these challenges, this study explores the implementation of a deep learning approach, which emphasizes in-depth, experiential, and student-centered learning to develop higher-order thinking skills (Suwandi et al., 2024). Deep learning encourages understanding rather than rote memorization, enabling students to integrate knowledge into their daily lives (Hasanah & Pujiati, 2025). Studies indicate that this approach effectively enhances critical thinking and collaboration skills among students.

Interactive learning media also plays a significant role in supporting deep learning. One such medium, Spedomatik Media, is designed to aid understanding of mathematical concepts, especially place value. The media consists of a stereofoam board covered with cardboard and equipped with three circles representing ones, tens, and hundreds places, each subdivided into ten segments (Setyawan, 2020). Through hands-on manipulation of these circles, students better comprehend and retain the concept of place value while engaging in collaborative discussion and problem-solving, promoting both critical thinking and collaboration.

Deep learning emphasizes mastering content, creating new knowledge, and developing meaningful learning skills. Mceachen & Kane (2016) explain that deep learning fosters content mastery, character development, citizenship, and 21st-century skills, known as the "6Cs": Character, Citizenship, Collaboration,

Communication, Creativity, and Critical Thinking. Kemendikdasmen (2025) defines deep learning as a student-centered approach that creates conscious, meaningful, and enjoyable learning through holistic engagement in thinking, feeling, and acting. Its framework comprises four components: graduate profile dimensions, learning principles, learning experiences, and learning frameworks. Graduate profile dimensions include faith and devotion to God Almighty, citizenship, critical reasoning, creativity, collaboration, independence, health, and communication, representing holistic competencies every student should attain.

Learning media plays a crucial role in supporting deep learning by actively stimulating student engagement and facilitating the comprehension of complex concepts (Kandia et al., 2023). Various types of learning media, including audio, visual, audio-visual, and multimedia, contribute to making lessons more structured, interactive, and effective, allowing students to internalize information more efficiently (Azhura et al., 2023). Among these, Spedomatik Media serves as an interactive visual tool specifically designed to enhance students' understanding of mathematical concepts, particularly place value. By enabling hands-on manipulation and group interaction, this media not only improves conceptual comprehension but also promotes collaborative problem-solving, discussion, and critical thinking, thereby supporting holistic learning outcomes in elementary education.

Collaboration skills involve effective teamwork to achieve shared goals and require mutual respect and collective decision-making (Anantyarta & Sari, 2025). In elementary classrooms, small group work can improve student engagement and participation (Buchori & Prasetyowati, 2020; Hendrawati et al., 2020). Critical thinking, involving analysis, hypothesis formation, and decision-making, is essential in 21st-century education (Sarifah & Nurita, 2023). It enables students to solve problems systematically, consider multiple perspectives, and produce evidence-based solutions, fostering character and responsiveness to environmental challenges (Anggraeni et al., 2022; Kemendikdasmen, 2025).

Based on this background, the present study aims to investigate the effect of implementing deep learning assisted by Spedomatik Media on enhancing elementary students' collaboration and critical thinking skills. By integrating interactive media with a deep learning approach, this research seeks to provide empirical evidence on how such strategies can foster students' active engagement, meaningful learning, and problem-solving abilities. The study is expected to offer valuable insights for educators in designing innovative instructional methods that are more responsive to the cognitive, social, and collaborative needs of students. Ultimately, it aims to support the development of learning environments that align with the competencies required for success in the 21st century, including teamwork, analytical thinking, and reflective decision-making.

2. Methodology

This study employs a quantitative approach. According to Arikunto in Syahroni (2022), quantitative research is a method of collecting, interpreting, and presenting data using numbers, tables, graphs, and images to reinforce the analysis of the data. Sugiyono (2022) explains that quantitative research is used to examine a specific population or sample using instruments and statistical data analysis to test hypotheses. The research was conducted in August 2025 at SDN 1 Sumberagung. This study uses a quasi-experimental design with a one-group pretest-posttest design. This design involves measuring the dependent variables before and after the treatment, with a single group receiving the intervention. The measurements are made by comparing the pretest and posttest scores to assess the changes that occurred after the intervention (Mukarrama, 2023).

The research variables consist of independent (X) and dependent (Y) variables. The independent variable (X) is the Deep Learning approach assisted by Spedomatik Media. This approach emphasizes deep understanding through reflective activities, problem-solving, and group discussions on the topic of Place Value in mathematics. The use of Spedomatik Media is expected to help visualize the concepts in an engaging and easily understandable way, as well as promote exploration and discussion during the learning process (Setyawan, 2020). The dependent variables (Y) are: (1) Student Collaboration Skills (Y1). The ability of students to work together with others in completing tasks or solving problems, which includes responsibility, compromise, productive work, and adaptability in various roles. (2) Critical Thinking Skills (Y2). The ability of students to develop basic skills, provide explanations, offer further explanations, draw conclusions, and strategize in problem-solving (Sarifah & Nurita, 2023).

The sample for this research consists of second-grade students at SDN 1 Sumberagung, selected using Purposive Sampling. This technique intentionally chooses participants based on specific criteria relevant to the study's objectives, ensuring that the students have the appropriate academic background and classroom engagement needed for meaningful data. By focusing on these selected students, the research can effectively examine the impact of Deep Learning assisted by Spedomatik Media on collaboration and critical thinking skills, enhancing the validity and relevance of the findings.

Research Instruments: (1) Observation Sheet. This instrument is used to record student activities and responses during the learning process. The observation sheet helps the researcher monitor student engagement, classroom atmosphere, and learning activities while applying the Deep Learning approach assisted by Spedomatik Media. (2) Collaboration Skills Questionnaire. The questionnaire is used to measure students' collaboration skills in mathematics, specifically regarding the topic of Place Value. The questionnaire is designed in a Likert scale format and administered after the lesson to assess the impact of the Deep Learning approach assisted by Spedomatik Media on students' collaboration skills. (3) Test (Pretest and Posttest). The test is used to measure students' behaviors or performance,

particularly their critical thinking abilities. The pretest is administered before the lesson to assess students' initial abilities, while the posttest is given after the treatment to evaluate the improvement in students' understanding of the material taught (Hasnunidah, 2017).

Data Collection Techniques: (1) Observation. Observation is conducted to systematically observe and record phenomena in the research object. In this case, observations are made to record students' activities and engagement during the learning process when applying Spedomatik Media. (2) Questionnaire. The questionnaire is used to gather information about students' preferences, beliefs, and behaviors related to their collaboration skills during the learning process. (3) Test (Pretest and Posttest). The test is used to measure changes in students' critical thinking skills before and after the application of Spedomatik Media. The pretest is conducted to measure students' initial skills, and the posttest is used to measure improvements in students' critical thinking abilities after the intervention.

Data Analysis Techniques: (1) Classical Learning Mastery Test (Proportion Test). This test is used to evaluate whether a class as a whole has achieved learning mastery, i.e., the percentage of students who meet the Minimum Completion Criteria (KKM) established for the subject. (2) Prerequisite Tests, which include:
(a) Normality Test. This test aims to determine whether the data follows a normal distribution. The normality test uses the Kolmogorov-Smirnov method, where data is considered normally distributed if the p-value is greater than 0.05. (b) Linearity Test. The linearity test aims to determine whether there is a linear relationship between the independent and dependent variables. This test is performed using the SPSS program, (c) Heteroskedasticity Test. This test is used to determine whether there is equal variance in the regression model. If the significance value is greater than 0.05, the hypothesis that there is no heteroskedasticity is accepted.

Hypothesis Testing includes: (1) Simple Linear Regression Test: This test is used to determine the impact of the Deep Learning approach assisted by Spedomatik Media on students' collaboration skills. The simple linear regression formula is:
$Y_1 = a + bX + e$, (2) Simple Linear Regression Test. This test is conducted to measure the impact of the Deep Learning approach assisted by Spedomatik Media on students' critical thinking skills. The regression formula is:
$Y2 = a + bX + e$, (3) Multivariate Analysis of Variance (MANOVA). This test is used to examine the variables simultaneously to determine the effect of the Deep Learning approach on students' collaboration and critical thinking skills using the SPSS application.

3. Results and Discussion

This study was conducted in a second-grade mathematics class at SDN 1 Sumberagung, consisting of 25 students, with 13 boys and 12 girls. Prior to this study, the class used conventional teaching methods, primarily teacher-centered learning with limited use of interactive media. Students were accustomed to

receiving explanations from the teacher, solving individual exercises, and participating in brief question-and-answer sessions. This learning approach had limitations in promoting collaborative and critical thinking skills, as most classroom activities focused on rote memorization and individual problem solving. Classroom observations before the research indicated low student engagement, minimal peer interaction, and limited opportunities for higher-order thinking tasks. The physical classroom environment included desks arranged in traditional rows, a blackboard at the front, and basic learning tools, with limited access to technology such as projectors or interactive media.

During the research period, Deep Learning assisted by Spedomatik Media was implemented to transform learning activities into student-centered, collaborative, and interactive experiences. The learning process involved small group discussions, problem-solving exercises using Spedomatik Media, and guided teacher facilitation. Students worked in groups to explore mathematical concepts, such as Place Value, using interactive visualizations provided by the Spedomatik Media. Teachers observed group interactions, encouraged reflection on problem-solving strategies, and provided immediate feedback to foster deeper understanding. The implementation followed structured lesson plans that integrated critical thinking prompts, collaborative tasks, and opportunities for students to present solutions to the class.

Data were collected through a combination of interviews, observations, and documentation. Interviews were conducted with the principal, teachers, and selected students to understand their experiences and perceptions regarding the learning process. Observations focused on student engagement, collaborative interactions, and the use of Spedomatik Media during lessons. Documentation included student worksheets, assessment results, and photographs of classroom activities. The research process followed ethical guidelines, ensuring voluntary participation, confidentiality, and informed consent from parents and teachers. The interview questions used to guide data collection are presented in Table 1.

Table 1. Interview Questions

No	Respondent	Questions
1	Teacher	How did you facilitate Deep Learning activities using Spedomatik Media?
2	Teacher	How do you assess students' collaboration and critical thinking during the lessons?
3	Student	How do you feel about working in groups using Spedomatik Media?
4	Student	Which parts of the learning activity helped you understand the material better?
5	Principal	How do you support teachers in implementing Deep Learning in the classroom?
6	Principal	What challenges have you observed during the implementation of Deep Learning?

Additionally, the Spedomatik Media employed in this study consisted of interactive modules and visual learning aids designed to enhance students' understanding of mathematical concepts. Figure 1 presents an example of the Spedomatik Media

interface used for Place Value exercises, allowing students to manipulate digits visually and comprehend number positions effectively. Figure 2 depicts collaborative group activities where students engaged with the media to solve problems together, promoting discussion, peer interaction, and joint problem-solving, thereby fostering both collaboration and critical thinking skills in an active learning environment.

Figure 1. Interactive Spedomatik Media for Place Value Visualization

Figure 2. Students Collaborating Using Spedomatik Media in Small Groups

The rest of the results, including classical learning mastery tests, normality, linearity, heteroskedasticity tests, and regression analysis, remain as previously

described, demonstrating the effectiveness of Deep Learning assisted by Spedomatik Media in improving students' collaborative and critical thinking skills.

The results of this study were analyzed using various statistical tests to ensure that the learning method applied had a significant impact on students' abilities in both of these skill areas. In this analysis, a classical learning mastery test was conducted to assess the proportion of students who achieved the Minimum Learning Mastery Criteria (KKTP), along with prerequisite tests to ensure the validity and reliability of the data. Subsequently, a simple linear regression test was conducted to measure the extent to which the independent variable, namely Deep Learning assisted by Spedomatik Media, affected the dependent variables Collaboration Skills and Critical Thinking Skills of students.

The results indicate a significant improvement in both collaboration skills and critical thinking skills of students after the implementation of this learning approach. The classical learning mastery results from the pretest before the implementation of the new method showed inadequate results, with only 0% of students achieving KKTP. However, after the implementation of Deep Learning assisted by Spedomatik Media, the classical learning mastery increased to 80%, with most students achieving scores that met the established standards. Furthermore, the analysis results of normality tests, linearity tests, and heteroskedasticity tests showed that the data was normally distributed and that the relationship between the independent and dependent variables was linear, which supports the validity of the regression results. Overall, the findings of this study provide a clear picture of the effectiveness of implementing Deep Learning in improving collaborative skills and critical thinking skills of elementary school students. The use of Spedomatik Media proved not only to aid the visualization of mathematical concepts, making them easier to understand, but also encouraged students to collaborate in groups and actively develop their analytical skills.

The classical learning mastery test was administered to determine the percentage of second-grade students at SDN 1 Sumberagung who achieved the Minimum Learning Mastery Criteria (KKTP) in the mathematics topic of Place Value, with the KKTP set at 70. This test was analyzed using the Proportion Test in SPSS 27, which enabled the researcher to statistically measure and compare the differences in students' critical thinking skills before and after the implementation of Deep Learning assisted by Spedomatik Media, providing a clear assessment of the intervention’s effectiveness.

The classical learning mastery test was conducted to determine the percentage of students who achieved the KKTP in the Place Value topic in mathematics in the second grade at SDN 1 Sumberagung. The KKTP was set at 70. This test was conducted using the Proportion Test in SPSS 27, which measures the differences in students' critical thinking skills before and after the application of Deep Learning assisted by Spedomatik Media. Before presenting the results of the proportion test, it can be explained that classical learning mastery refers to the percentage of students who successfully achieved the KKTP value, which indicates the success

of the learning method. The following Table 2 shows the results of the pretest conducted before the implementation of Deep Learning assisted by Spedomatik Media.

Table 2. Proportion Test Pretest

Category	N	Observed Proportion	Test Proportion	Exact Significance (2-tailed)
Pretest Score	25	1.00	0.50	0.000

Source: Data processed using SPSS

Based on the pretest results, all students (25 students) scored below the KKTP, indicating that the classical learning mastery before the implementation of Deep Learning assisted by Spedomatik Media was 0%. This shows that initially, students were unable to meet the established learning mastery standards. The following Table 3 shows the posttest results after the implementation of Deep Learning assisted by Spedomatik Media.

Table 3. Proportion Test Posttest

Category	N	Observed Proportion	Test Proportion	Exact Significance (2-tailed)
Posttest Score	25	0.80	0.50	0.004
<= 70	5	0.20	0.50	

Source: Data processed using SPSS

Based on the posttest results, 20 students (80%) achieved the Kriteria Ketuntasan Tujuan Pembelajaran (KKTP), while 5 students (20%) did not reach the KKTP. This indicates an 80% improvement in classical learning mastery, demonstrating the effectiveness of implementing Deep Learning assisted by Spedomatik Media in enhancing students' achievement. The results show that most students were able to better understand the material after the intervention, highlighting the positive impact of this approach on their learning outcomes. The improvement suggests that combining Deep Learning with interactive media can significantly enhance student comprehension and academic performance in elementary education.

Before conducting hypothesis testing, several prerequisite tests were performed to ensure the adequacy and validity of the data for subsequent analysis. These tests, including normality, linearity, and heteroskedasticity tests, serve as essential preliminary steps in the data analysis process. They help determine whether the assumptions underlying the statistical techniques to be used are met. Ensuring that the data meets these assumptions is crucial for obtaining reliable and accurate results. If the assumptions are violated, the conclusions drawn from the statistical tests could be misleading, leading to incorrect interpretations. By conducting these tests beforehand, we can verify that the data is suitable for the planned analyses, thereby improving the robustness of the findings and ensuring the integrity of the hypothesis testing process. These prerequisite tests collectively assess various aspects of the data distribution and relationships, laying the groundwork for valid and meaningful hypothesis testing.

Normality Test

The normality test aims to determine whether the data follows a normal distribution. The results of the normality test using Shapiro-Wilk showed that the significance value for all variables was greater than 0.05, indicating that the data was normally distributed. Before proceeding with the analysis, it is important to note the results of the normality test, which indicate whether the data meet the normal distribution assumption. The results of the normality test are presented in Table 4.

Table 4. Normality Test Results

Variable	Shapiro-Wilk Sig	Remarks
Deep Learning Assisted by Spedomatik	0.253	Normal
Collaboration Skills	0.082	Normal
Critical Thinking Skills	0.092	Normal

Source: Data processed using SPSS

Based on the Shapiro-Wilk results, the significance values for all three variables were greater than 0.05, indicating that the data for these variables are normally distributed and can proceed to further analysis. This outcome suggests that the assumption of normality required for many parametric statistical tests, including regression analysis, has been met. A normal distribution is essential because it ensures that the results of subsequent statistical tests are valid and reliable. If the data had shown significant deviations from normality, alternative non-parametric methods would have been considered. Since the normality assumption holds, we can confidently proceed with hypothesis testing and other statistical analyses, knowing that the underlying conditions for accurate inference are satisfied.

Linearity Test

The linearity test was conducted to assess the linear relationship between the independent and dependent variables. Based on the results of the linearity test, it was found that the relationship between Deep Learning assisted by Spedomatik Media and Collaboration Skills (Y_1) as well as Critical Thinking Skills (Y_2) showed a linear relationship. The test results are shown in Table 5 below:

Table 5. Linearity Test Results

Variable	Significance	Remarks
Deep Learning Assisted by Spedomatik (X) to Collaboration Skills (Y1)	0.956	Linear
Deep Learning Assisted by Spedomatik (X) to Critical Thinking Skills (Y2)	0.648	Linear

Source: Data processed using SPSS

The significance value for Deep Learning assisted by Spedomatik Media on Collaboration Skills was 0.956, which is greater than 0.05, indicating that there is a linear relationship between these two variables. The linearity test for Critical Thinking Skills showed a significance value of 0.648, which is also greater than

0.05, indicating a linear relationship between Deep Learning assisted by Spedomatik Media and Critical Thinking Skills.

Heteroskedasticity Test

The heteroskedasticity test was used to ensure that there was no unequal variance in the regression model. The results showed no evidence of heteroskedasticity, meaning the data met the homoscedasticity assumption. The significance value of 0.507 and 0.169 was greater than 0.05, indicating that there was no heteroskedasticity, and the regression model used is acceptable. This is briefly presented in Table 6 below:

Table 6. Heteroskedasticity Test Results

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
(Constant)	0.002	3.313		0.001	0.999
Deep Learning Assisted by Spedomatik to Collaboration Skills (Y1)	0.029	0.044	0.139	0.674	0.507
(Constant)	5.162	5.481		0.942	0.356
Deep Learning Assisted by Spedomatik to Critical Thinking Skills	0.102	0.072	0.284	1.418	0.169

Hypothesis Testing

To test the research hypotheses, a simple linear regression was performed. The results of the simple linear regression test showed that Deep Learning assisted by Spedomatik Media had a significant impact on both Collaboration Skills and Critical Thinking Skills of students. The regression results for Deep Learning assisted by Spedomatik Media on Collaboration Skills are shown in Table 7 below:

Table 7. Simple Linear Regression of Deep Learning Assisted by Spedomatik Media on Students' Collaboration Skills

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
(Constant)	47.250	7.021		6.730	0.000
Deep Learning Assisted by Spedomatik	0.442	0.092	0.706	4.787	0.000

Source: Data processed using SPSS

The simple linear regression equation for Collaboration Skills is:
$Y_1 = 47.250 + 0.442X$. This indicates that for every unit increase in Deep Learning assisted by Spedomatik Media, students' collaboration skills improve by 0.442. This result shows that Deep Learning, supported by Spedomatik Media, positively impacts students' collaboration skills. The coefficient of 0.442 suggests that greater engagement with this approach leads to improved collaboration. The statistical significance of this regression equation confirms the effectiveness of using interactive learning tools to enhance collaboration in the classroom. The results of

the simple linear regression for Deep Learning assisted by Spedomatik Media on students' Critical Thinking Skills are shown in Table 8 below:

Table 8. Simple Linear Regression of Deep Learning Assisted by Spedomatik Media on Students' Critical Thinking Skills

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
(Constant)	22.684	9.175		2.473	0.021
Deep Learning Assisted by Spedomatik	0.715	0.121	0.777	5.924	0.000

Source: Data processed using SPSS

The regression equation for Critical Thinking Skills is: $Y_2 = 22.684 + 0.715X$. This indicates that for every unit increase in Deep Learning assisted by Spedomatik Media, students' critical thinking skills improve by 0.715. This shows that Deep Learning, supported by Spedomatik Media, positively impacts students' critical thinking abilities. The coefficient of 0.715 suggests that greater engagement with this approach leads to significant improvement in critical thinking. This highlights the effectiveness of interactive learning in fostering deeper cognitive engagement and reflective thinking in students.

Discussion

This study aims to examine the impact of implementing the Deep Learning approach assisted by Spedomatik Media in improving collaborative skills and critical thinking skills in elementary school students, specifically in the topic of Place Value in mathematics for second-grade students. The findings indicate that the implementation of this learning design effectively enhances both skills. The learning process was conducted over four sessions, each lasting 2 x 35 minutes. The teaching modules used were equipped with instructional materials and Student Activity Sheets (LKPD) for collaborative group work to support discussion activities. The principles of Deep Learning applied in this study include three main aspects: awareness, enjoyment, and meaning.

According to the Ministry of Education and Culture (Kemendikdasmen, 2025), awareness-based learning begins by linking the subject matter with real-life experiences that are close to the students' lives. The application of this principle in the Place Value lesson aimed to engage and focus students. In this study, the introduction phase (aperception) at the beginning of the lesson was a key effort to increase students' awareness of the benefits of the material being taught, thus making them more active in the learning process. The principle of enjoyment in learning was applied through the use of Spedomatik Media, which aims to create a non-boring and motivating learning atmosphere. This media helps visualize abstract concepts, making them more concrete and easier to understand by students (Setyawan, 2020). Furthermore, the principle of meaningful learning was applied by using group discussions accompanied by collaborative LKPD. This method provided students with the opportunity to interact and develop their critical thinking skills through joint information processing. The application of Deep Learning

principles, including the stages of understanding, applying, and reflecting, allowed students to not only deeply understand the material but also apply it in meaningful activities and reflect on the learning process. Through these stages, students were expected to be actively involved in the learning process, both in group discussions and in deep reflection on the concepts they had studied (Fullan et al., 2018).

Influence of Deep Learning Assisted by Spedomatik Media on Students' Collaboration Skills

The findings of this study indicate that the implementation of Deep Learning assisted by Spedomatik Media had a positive and statistically significant impact on students' collaboration skills. This conclusion is supported by the results of the t-test, where the calculated t-value (4.787) exceeded the critical t-table value (1.66543), and the significance level was 0.000, which is below the 0.05 threshold. These results demonstrate that using Deep Learning combined with Spedomatik Media effectively fosters collaboration, a key component of 21st-century skills emphasized in the Deep Learning framework.

The combination of Deep Learning principles with the use of Spedomatik Media created a more interactive and collaborative learning environment. Spedomatik Media, which serves as a visual and interactive tool, helped students actively participate in group activities. In this study, students were able to work together effectively, demonstrate a spirit of cooperation, take on and perform roles with responsibility, and maintain positive relationships within the group. This finding aligns with the research conducted by Arif et al. (2025), which states that Deep Learning can support the development of collaboration skills through group-based learning, where students learn to cooperate and communicate effectively.

Based on the coefficient of determination (R^2), the application of Deep Learning assisted by Spedomatik Media accounted for 49.9% of the variance in students' collaboration skills, while the remaining 50.1% was influenced by other factors not investigated in this study. The improvement in collaboration skills was evident through students' increased proactivity during group discussions, greater respect for the ideas and contributions of their peers, and the development of a more harmonious and supportive classroom environment, demonstrating the effectiveness of this interactive learning approach.

Influence of Deep Learning Assisted by Spedomatik Media on Students' Critical Thinking Skills

This study further demonstrates that the implementation of Deep Learning assisted by Spedomatik Media had a positive and significant effect on students' critical thinking skills. The statistical analysis revealed a t-value of 5.924, which exceeds the t-table value of 1.665, and a significance level of 0.000, indicating a strong impact. Consequently, it can be concluded that this learning approach effectively enhances critical thinking abilities, enabling students to comprehend meanings,

analyze connections between concepts, evaluate information critically, and apply their understanding to real-life problem-solving situations.

These results are consistent with findings by Meilani et al. (2025), who state that Deep Learning-based learning, which focuses on deep understanding, critical reflection, and connecting concepts with real-world contexts, is effective in enhancing students' analytical and problem-solving abilities. This approach encourages students not only to memorize facts but also to link relevant ideas and concepts and generate solutions based on available evidence. Based on the calculation of the coefficient of determination (R^2), the impact of the application of Deep Learning assisted by Spedomatik Media on students' critical thinking skills was 60.4%, while the remaining variance was influenced by factors not examined in this study. This shows that Deep Learning assisted by Spedomatik Media significantly contributes to the development of students' critical thinking skills.

Influence of Deep Learning Assisted by Spedomatik Media on Students' Collaboration and Critical Thinking Skills Simultaneously

A MANOVA (Multivariate Analysis of Variance) was conducted to examine the simultaneous impact of the application of Deep Learning assisted by Spedomatik Media on students' collaboration and critical thinking skills. The results of this test showed a significance value of 0.000, which is smaller than 0.05, indicating that there is a significant effect of the implementation of Deep Learning assisted by Spedomatik Media on both skills simultaneously. This result is in line with the research conducted by Akmal et al. (2025), who concluded that the Deep Learning approach promotes deep understanding of learning materials through critical, reflective, creative, and applied thinking processes. In Deep Learning, students do not only memorize facts but also integrate new knowledge with existing knowledge and apply it in broader, more relevant contexts in real life. This approach also encourages active student involvement through social interaction, which enhances skills such as problem-solving, innovation, and collaboration.

4. Conclusion

Based on the results of the study, it can be concluded that the implementation of Deep Learning assisted by Spedomatik Media has a significant impact on enhancing collaborative skills and critical thinking skills in elementary school students. The application of the learning approach that is conscious, meaningful, and enjoyable has proven to create a more interactive and engaging learning environment, which increases active student participation in the learning process. Regarding collaborative skills, the application of Deep Learning assisted by Spedomatik Media successfully improved students' ability to work effectively in groups, showing an increase in classical learning mastery from 0% in the pretest to 80% in the posttest. This indicates that students not only understood the material better but also became more open to discussing and collaborating with their group mates.

A significant improvement in critical thinking skills was also observed after the implementation of this method, with the t-value being greater than the t-table value and an R^2 value showing that Deep Learning assisted by Spedomatik Media contributed 60.4% to the enhancement of students' critical thinking skills. This approach encourages students not only to memorize material but also to analyze, connect learned concepts, and apply them in real-life situations. Moreover, the results of the MANOVA test show that the application of this learning method has a significant simultaneous effect on both skills, namely collaborative skills and critical thinking skills. This indicates that Deep Learning assisted by Spedomatik Media is not only effective in improving specific skills but also influences the holistic development of students' competencies.

Overall, the findings of this study confirm that the implementation of Deep Learning assisted by Spedomatik Media serves as an effective and promising alternative for enhancing elementary students' collaboration and critical thinking skills, which are crucial competencies in 21st-century education. The study demonstrates that active engagement with interactive media fosters meaningful learning experiences, improves problem-solving abilities, and strengthens teamwork. These results are expected to provide valuable insights and serve as a reference for educators in developing more innovative, student-centered learning strategies that maximize participation and promote deeper understanding.

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