Proceedings of International Conference on Islamic Education (ICIED)
Impactful Education: Integrating Technology, and Ecotheological Values For a Sustainable Future
Volume 10, 2025 (p-ISSN 2477-3638 / e-ISSN 2613-9804)

The Effectiveness of Using Educaplay Media with a Deep Learning Approach to Improve Students' Critical Thinking Skills

Candra Avista Putri[1], Nur Hidayah Hanifah[2], Ahmad Syaifuddin[3]

Correspondence:
Candraavista24@gmail.com

Affiliation:
Universitas Islam Negeri Maulana Malik Ibrahim Malang, Indonesia[1]
Candraavista24@gmail.com

Universitas Islam Negeri Maulana Malik Ibrahim Malang, Indonesia[2]
Nurhidayahhanifah@uin-malang.ac.id

MI Mambaul Ulum Dagan Lamongan, Indonesia[3]
ahmaddagan@gmail.com

Abstract
Social studies subjects, which are only dominated by memorization and one-way lectures, make students passive and have difficulty relating to real life, so they require innovation in learning methods to optimize students' critical thinking skills. The purpose of this study is to determine the influence of the use of Educaplya media with a Deep Learning approach on students' thinking ability in elementary school. The method of this study is quantitative, with a Quasi Experimental Control Group Design approach. The subjects in this study were 44 grade VI students, which were divided into control and experimental classes. The data collection techniques carried out were observation, interviews, and tests. Data analysis used the Independent Sample t-test with the prerequisites of normality and homogeneity tests. The results of the Independent Sample t-test in the statistical test showed that the gain of sig values was 0.000 < 0.05 so that it can be stated that there is an influence of the use of Educaplay media on students' critical thinking skills. This study provides recommendations for educators in elementary schools to utilize technology with an approach that is in accordance with the needs and developments of the times. For example, Educaplay can be used as a support during the learning process.

Keywords:
Media Educaplay; Deep Learning; Critical Thinking

A. INTRODUCTION

Critical thinking skills including analysis, evaluation, conclusion making, and evidence based decision making are fundamental competencies in the 21st century education era (Aktoprak & Hursen, 2022; Hafeez, 2021). At the elementary school level, these abilities are essential for shaping scientific mindsets, strengthening science literacy, and fostering deep conceptual understanding (Aiman et al., 2020; Osterhaus et al., 2017). However, in practice, developing critical thinking skills still faces various challenges in science learning, such as limited media, inadequate teacher training, and poor technology integration. Therefore, in depth empirical studies are needed to assess the effectiveness of interactive learning media in fostering students' critical thinking skills in a more optimal and contextual manner (Kadbey et al., 2015; A. Ramadhani, 2025)

Findings in the field show that many students have difficulty understanding science material thoroughly. The dominant learning method focuses on memorization and one way lectures making students passive and have difficulty associating concepts with real phenomena around them (Akram et al., 2022)(Akram et al., 2022)(Gazit et al., 2005)(Nasution & Dea, 2025)(S. Ramadhani & Maulana, 2019). This situation is further supported by evidence indicating that incorporating interactive multimedia into elementary education contributes to the enhancement. Moreover, the availability of sufficient digital media is recognized as a pressing requirement for fostering scientific literacy at the primary (Mardiana et al., 2020)

One of the main factors contributing to the low quality of learning is the lack of innovation. Reliance on traditional learning models that are one way, monotonous, and less interactive tends

to position students as passive recipients of information. This situation does not provide adequate space for students to engage in reflective, exploratory thinking processes, or to directly test concepts through meaningful learning experiences. As a result, students' potential to develop analytical, creative, is hampered. In the context of education, which demands higher-order thinking skills and digital literacy, innovative and technology-based learning approaches are crucial for creating a dynamic, participatory, and transformative learning environment (Bali et al., 2020)(Kozanitis & Nenciovici, 2023)(Yasa et al., 2023). Lebih jauh lagi, integrasi media interaktif digital memberikan dampak yang signifikan (Arni et al., 2024)(Saputra et al., 2025). Therefore, the development of innovative and interactive learning media is an important strategy to support the strengthening of critical thinking skills.

Several previous studies have shown a positive contribution to the use of interactive digital media in improving the quality of IPAS learning in elementary schools. Research by (Mukni'ah et al., 2025) found that the use of Educaplay in science learning is able to improve students' reasoning skills and concept understanding through structured game-based activities. Furthermore, (Nur'aeni et al., 2025) Educaplay can increase learning motivation and activate high-level thinking processes through interactive quizzes and problem-solving-based exercises On the other hand, research by (Chen et al., 2025) shows that deep learning algorithms are effectively used to analyze students' learning patterns and automatically provide recommendations for additional materials, although their application in the context of elementary school science learning is still very limited. Another study by (Lu et al., 2023) also confirms that interactive multimedia integration can improve students' critical thinking skills, but has not yet combined it with artificial intelligence for personalization of learning. The findings show that studies on Educaplay have reviewed many aspects of interactivity and motivation, while research on deep learning emphasizes learning data analysis, so the opportunity to integrate the two in the context of elementary school science learning is still wide open.

The approach used combines *the Educaplay* digital platform with *a deep learning* method that is oriented towards adapting students' learning patterns. Through this synergy, learning on material on the change in the form of substances not only becomes more interactive and interesting, but also more responsive to individual learning needs. In contrast to the use of digital media which generally only emphasizes increased learning motivation, this approach allows the system to adjust the level of difficulty, provide personalized, reflectively and information based. Thus, the learning process becomes more adaptive, meaningful, and supports to deeper conceptual understanding at the elementary school level.

The gamebased learning approach through digital platforms such as Educaplay has proven to be effective because it combines educational and entertainment elements through quizzes, quizzes, and logic games that are appropriate to the teaching material, so that students are actively involved and at the same time practice critical thinking skills (Nadilah et al., 2025)(Nurhayati et al., 2025). With the support of deep learning methods, the system can also analyze students' learning patterns, adjust difficulty levels, provide personalized feedback, and recommend additional materials as needed, making learning more adaptive, reflective, and data driven to develop critical, creative, reflective thinking skills at the primary education level (Feri et al., 2025). This combination provides an interactive and engaging learning experience that is both effective.

Empirical evidence supports the effectiveness of using this platform. The use of Educaplay has been shown to increase students' motivation, engagement, and understanding, while strengthening their critical thinking skills. Its application to the material of changes in the form of substances allows students to reason logically, draw conclusions, and make information based decisions, so that the understanding of concepts becomes more real and relevant to daily life (Lu et al., 2023)(Ningrum et al., 2025). Therefore, this media integration classroom engagement, and fosters critical thinking in students at the sixth grade level.

Previous studies have focused more on the effects of Educaplay on learning motivation and engagement, but have not in-depth assessed how this medium can be combined with deep learning approaches to analyze students' learning patterns and provide quantitative

personalization. On the other hand, research on deep learning in elementary education generally focuses on image recognition, object classification, or prediction systems, but has not been directed at improving conceptual understanding and critical thinking on the topic of substance form change. Therefore, the combination of Educaplay and deep learning is important because it provides interactivity and game-based activities that encourage active engagement, while deep learning ensures that the system can adjust the level of difficulty, provide learning recommendations, and reinforce an in-depth understanding of concepts that have not been explored in much of the previous research. Based on these gaps, this study aims to analyze the effectiveness of the integration of Educaplay and deep learning in improving the critical thinking skills of elementary school students on substance form change materials.

By considering these various studies, The integration of Educaplay as an interactive learning medium on substance change materials is the right strategy. This interactive learning media can increase student motivation and active participation, while strengthening their conceptual understanding and analytical skills. With characteristics that support active and reflective learning, this media aligns with the demands of 21st century education, which emphasizes mastery of critical, creative, collaborative, and communicative thinking skills.

B. METHODS

This study employed a quantitative framework utilizing an experimental methodology. The selected approach was deemed suitable for examining the impact of integrating Educaplay media with a Deep Learning strategy on the dependent variables. To facilitate this investigation, a Quasi Experimental Control Group Design was implemented, enabling a systematic comparison between the experimental and control groups both prior to and following the intervention. The location of the research was conducted at MI Mambaul Ulum Dagan Lamongan. The population in this study includes all grade VI students divided into two classes. The research sample was determined using the cluster sampling technique, where one class was selected as an experimental class that received learning using Educaplay media, while the other class acted as a control class that followed learning using conventional methods. Through the design, the effectiveness of the use of learning media can be analyzed in a structured manner to assess its influence on students' critical thinking skills.

This study involves two main variables, namely the free variable in the form of the application of the Eduplay educational game in IPAS material changes in the form of objects and the bound variable in the form of students' critical thinking skills. The measurement of critical thinking ability is carried out using instruments developed based on five main indicators adapted from the Ennis framework of thinking which include the ability to give simple explanations, build basic skills, draw conclusions, convey further explanations, and design strategies and tactics.

The research data was obtained through several data collection methods designed to produce comprehensive and in-depth findings. The primary technique used was a critical thinking skills test, which was administered in two stages: a pretest and a posttest, to measure changes in student abilities before and after the learning intervention. The test questions used were multiple-choice questions, and a validity test was carried out to the experts and a reliability test was carried out with Cronbach's Alpha 0.6 (Govindasamy et al., 2024). To strengthen the test results, direct observations of student engagement during the learning process were conducted, providing a contextual overview of classroom dynamics. Furthermore, interviews were used to explore students' and teachers' perceptions and experiences regarding the learning process, while documentation was utilized to collect relevant supporting data, such as learning tools and student work results.

The pretest and posttest data were examined using parametric statistical techniques to evaluate the research hypothesis. Before conducting the hypothesis test, prerequisite analyses were performed to confirm that the data met the required statistical assumptions. Shapiro test used to test data were normally distributed, while the Levene test was applied to assess the uniformity of variance between groups, as a prerequisite for further statistical analysis. These tests ensured that the dataset followed a normal distribution and had equal variance, as indicated

by a significance value (Sig.) greater than 0.05. When these assumptions were fulfilled, an Independent Samples t-test was carried out to identify any significant differences in critical thinking abilities between the experimental group, which engaged in learning through Eduplay media, and the control group, which used traditional teaching methods. The complete data analysis process is depicted in Figure 1.

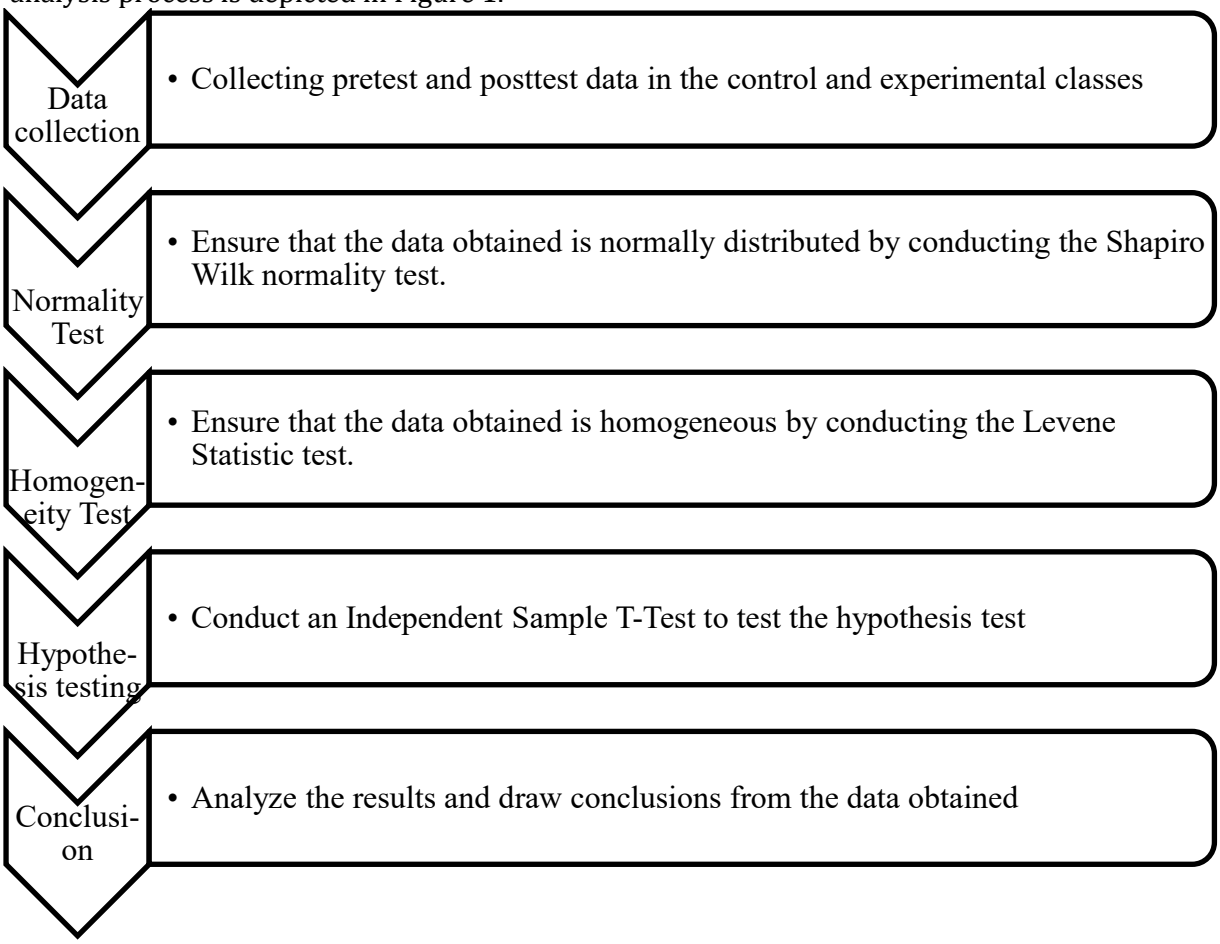

Figure 1. Statistical Data Analysis Process

C. RESULT & DISCUSSION

Result

The Educaplay media was designed based on the material on changes in state of matter in science lessons, with the aim of supporting conceptual understanding in a visual, interactive, and accessible way for students. Through its engaging display and responsive features, this media helps students connect abstract concepts with concrete representations, making the learning process more meaningful and enjoyable. This media is flexible because it can be used both individually and in classical learning, and has a smart interface that is easy to operate by both students and teachers. This convenience allows students to be actively involved in the learning process, not only as recipients of information, but also as subjects who explore and construct knowledge independently. The variety of educational games offered such as quizzes, crosswords, and picture matching are a unique attraction that can increase student interest and motivation in learning. Thus, Educaplay functions not only as an open tool, but also as a medium that encourages students' cognitive and affective involvement in science learning. The appearance of the Educaplay media used in this study can be seen in Figure 2.

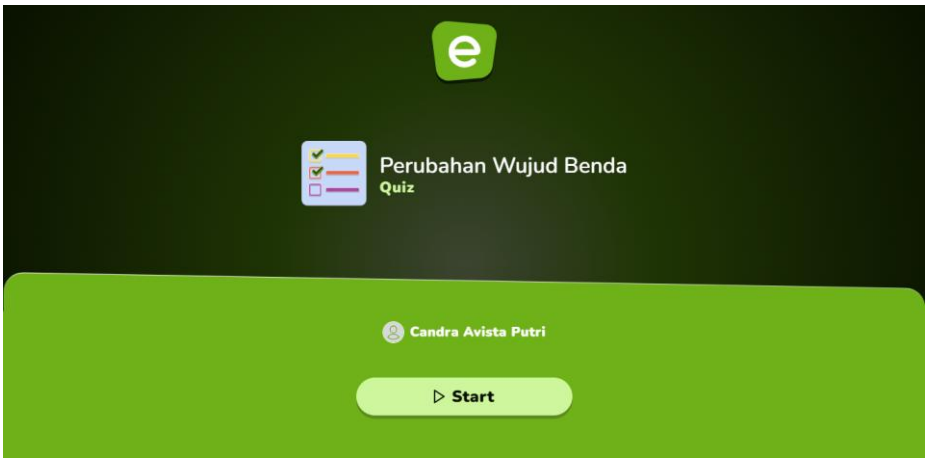

Figure 2. Educaplay Quiz Mode Question Display

In addition to quizzes, Educaplay offers a variety of other educational games that allow for flexible and contextual question integration. Features like crossword puzzles, concept matching, and other interactive games provide teachers with the opportunity to plan engaging and meaningful learning activities. Within the context of critical thinking-based learning, Educaplay accommodates questions designed around higher-order thinking syntax, such as analyzing, listening, and drawing conclusions. Thus, games serve not only as a means of entertainment but also as a strategic platform for honing students' reflective and logistical thinking skills without neglecting the academic essence of each question. The other options presented in the Educaplay media are presented in Figure 3.

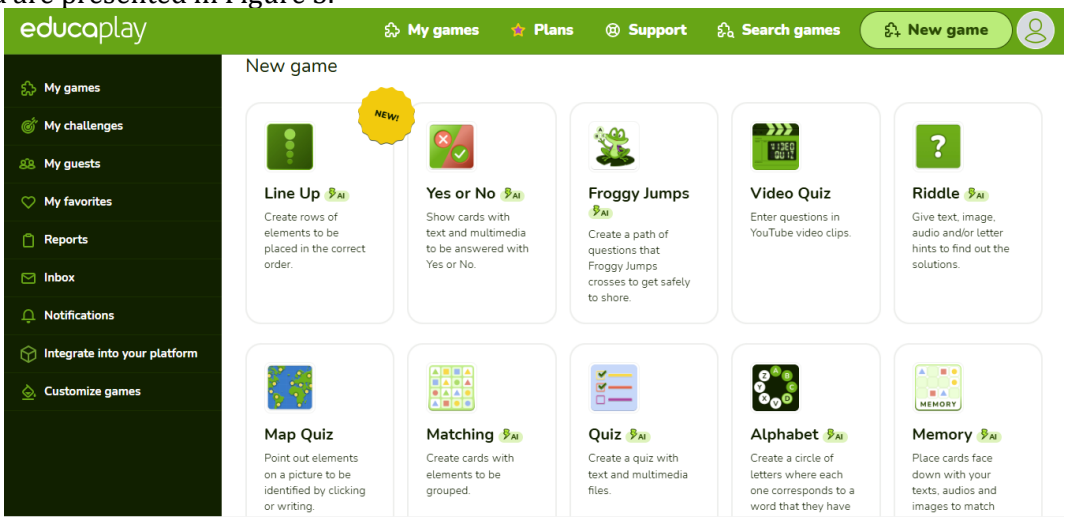

Figure 3. Menu New Game Educaplay

This study to evaluate Educaplay combined with the Deep Learning approach in improving the thinking skills of sixth-grade students at MI Mambaul Ulum Dagan Lamongan on the topic of changes in the state of matter in science learning. This approach encourages students to build understanding actively, reflectively, and contextually, while simultaneously honing higher-order thinking skills. The research design used was Quasi Experimen Control Group Design, this study involved 44 students who were divided into a control class consisting of 22 students with conventional learning, the experimental class consisted of 22 students with learning using Educaplay. The questions used in this study have gone through an expert judgment process by competent experts in their fields. Based on the results of the evaluation which included aspects of material suitability, construction, and language, the experts stated that all question items met the validity criteria and were declared suitable for use as a research instrument with a score of 82%. Meanwhile, the results of Alpa Cronbach's calculations are presented in table 1.

Table 1. Reliability Statistics

Cronbach's Alpha	N of Items
.630	10

So based on the reliability calculation value of the question showing a value of 0.630 which means it is greater than 0.6, it can be interpreted that the question is reliable and can be used. The research process was carried out in three main stages: pretest to measure initial ability, followed by treatment, and ended with a posttest to assess the impact of the intervention. The measuring instrument used is a test instrument developed based on the critical thinking indicator from Ennis(Ennis, 1991). Quantitative data in the form of a comparison of the average pretest and posttest scores from the two classes is presented in detail in Table 2.

Table 2. Average Pretest and Posttest Scores of Critical Thinking Ability

Class	Pretest	Posttest	Increased
Control	57	61	04
Experiment	55	83	28

The data in Table 2, both the experimental and control shows an improve in their scores after the learning activities. However, the experimental group, which used Educaplay media integrated with a Deep Learning approach, demonstrated a more substantial increase in average critical thinking scores than the control group that engaged in traditional learning. This indicates that the combination of Educaplay media and the Deep Learning approach effectively supports students in developing higher order thinking skills. Prior to conducting the hypothesis test, the outcomes of the normality test are presented in Table 3.

Table 3. Normality Test Results of Posttest Data

Class	Sig.	Conclusion
Control	0.095	Normal
Experiment	0.113	Normal

The homogeneity test reinforces the assumption that the variance of these two classes is homogeneous, shown in Table 4.

Table 4. Results of the Posttest Data Homogeneity Test

Levene Statistic	df1	df2	Sig.	Conclusion
0.938	1	42	0.338	Homogeneous

Based on the results of the normality and homogeneity tests, it was confirmed that the data were both normally distributed and homogeneous, indicating that the prerequisite conditions were satisfied. The next step was to perform a hypothesis test to determine whether there was a significant difference between the control and experimental groups. An Independent Samples t-test was employed to compare the mean scores of the two independent groups. This analysis aimed to examine whether the implementation of Educaplay media combined with a Deep Learning approach in teaching science concepts related to changes in the form of objects had a significant influence on students' critical thinking abilities. The obtained t-value and significance level served as indicators to assess whether the difference in posttest scores between the two groups was statistically meaningful, thereby supporting conclusions about the effectiveness of the learning intervention. The complete t-test results are displayed in Table 5.

Table 5. T-test results of posttest data

F	Sig.	t	df	Sig. (2-tailed)
0.938	0.338	7.053	42	0.000

The results of the Independent Samples t-test revealed a significant difference between the experimental group that utilized Educaplay media with a Deep Learning approach and the control

group that engaged in conventional instruction. As presented in Table 4, the analysis of the posttest data produced an F-value of 0.938 with a significance level (Sig.) of 0.338. Since this value exceeds 0.05, it indicates that the data possess homogeneous variance, thereby meeting the assumption of equal variances. Furthermore, the t-test results showed a t-value of 7.053 with 42 degrees of freedom (df) and a significance value (Sig. 2-tailed) of 0.000. Because this significance level is below 0.05, it confirms that there is a statistically significant difference between the two groups in the posttest scores. Therefore, it can be inferred that the treatment applied in this research had a meaningful impact on enhancing students' learning outcomes, suggesting that the implemented media or intervention effectively improved learning achievement after the treatment.

Discussion

The findings of this study indicate that the use of Educaplay media combined with a Deep Learning approach has a significant positive impact on improving students' critical thinking skills. Through interactivity and reflective learning strategies, students are encouraged to analyze information more deeply and develop contextual understanding. The results of the Independent Samples t-test revealed a significance value of 0.000 (< 0.05), demonstrating a statistically significant difference in posttest outcomes between the experimental. This statement confirms that learning supported by Educaplay media is more effective in developing students' critical thinking skills than conventional methods. The interactivity and educational game-based design encourage students to analyze, reflect, and connect concepts independently, creating a more. The results also reinforce the theoretical foundation of this study, emphasizing that nurturing critical thinking from the primary school level students with the higher-order thinking demanded 21st century education (Çavuş et al., 2025)

Educaplay media allows students to actively learn through interactive activities such as quizzes, puzzles, educational games, and problem based exercises. The activity encourages students to think analytically, solve problems, and evaluate their own answers, which are important indicators in critical thinking as stated by (Ennis, 1991). This process not only strengthens conceptual understanding, but also fosters the ability to assess the correctness of information and make evidence based decisions. This finding corroborates earlier studies demonstrating not only exerts impact skills but also nurtures learners' capacity to analyze, evaluate, and draw reasoned conclusions (Mao et al., 2021). These findings indicate that media such as Educaplay has a powerful potential in improving higher level thinking skills, including analysis, evaluation, and logical inference. In this context, Educaplay plays a role not only as an educational entertainment medium, but as a gradual thinking tool that helps students internalize concepts through analytical and reflective thinking processes.

When combined with the Deep Learning approach, learning not only focuses on mastering the material on the surface learning, but also emphasizes deep understanding, the connection between concepts, and the application of knowledge in new contexts. This is in line with the findings that deep learning encompasses two main aspects: meaningful learning and knowledge transfer to new situations(Pan et al., 2023). In practice, students with this approach not only memorize, but also connect new ideas with previous knowledge, criticize assumptions, and actively build understanding so that the learning process becomes more meaningful and immersive(Chukwuemeka & Garba, 2024). Thus, the integration of learning media based on a deep learning approach contributes significantly to creating a more holistic and transformative learning process. Through learning experiences that emphasize elaboration, reflection, and connections between concepts, students not only passively absorb information but actively construct meaningful and contextual understanding. They are trained to become reflective learners capable of evaluating their own thinking processes and adapting to the challenges and dynamics of ever-evolving knowledge. The role of students shifts from mere recipients of material to empowered subjects in the knowledge construction process, in line with educational demands that emphasize independent learning, digital literacy, and higher-order thinking skills.

This study's findings are consistent with those of (Bal & Öztürk, 2025) who demonstrated

that employing a deep learning based instructional model enhances learners' critical thinking abilities by fostering elaboration and reflective thinking. In addition, the results of (Sudarmono et al., 2025) research also support that interactive digital media is able to strengthen students' learning motivation and analytical skills. This statement reinforces the view that intrinsic motivation fostered through a game based learning approach plays a strategic role as a catalyst in developing reflective and highly reasoned thinking processes. When students are actively and emotionally engaged in fun and challenging learning activities, such as those facilitated by Educaplay, they tend to demonstrate improvements in their ability to critically process information, build connections between concepts, and reflect on their understanding independently. The use of Educaplay not only enriches the learning experience through engaging interactivity and visualizations, but also encourages the construction of more meaningful and contextual knowledge, in line with 21st century learning principles that emphasize active engagement, problem solving, and digital literacy.

Educaplay media provides opportunities for the application of differentiated learning that is able to accommodate a variety of learners' learning styles, both visual, auditory, and kinesthetic. According to (Goyibova et al., 2025), this kind of approach is effective in reaching students with different backgrounds of initial abilities. Through the automatic evaluation feature and repeated self study opportunities, students can adjust their learning process according to their own pace without pressure, so that learning outcomes improve more evenly. From a theoretical perspective, these findings reinforce Vygotsky's constructivist view that emphasizes the importance of social interaction and scaffolding in the learning process. The collaborative use of Educaplay through group discussion activities or team based assignments is able to create an optimal proximal development zone for students.

Practically, the use of Educaplay provides high flexibility in the design and implementation of learning activities. Educators can easily design, customize, and share materials with learners without having to rely on complicated hardware or software. This condition makes the learning process more efficient and economical, especially for elementary schools that have limited facilities. Thus, this discussion emphasizes such as Educaplay in Indonesian learning is a strategic step to improve learning outcomes, foster student motivation, and strengthen mastery of 21st century skills.

From a pedagogical perspective, the application of Deep Learning based Educaplay media has important implications for learning practices in schools. The *deep learning* approach in learning aims to foster critical thinking skills, create meaningful new knowledge, and understand the relationship between concepts(Kovač et al., 2025). This process requires the active involvement of students so that learning takes place in depth and meaning. Through interactive media such as *Educaplay*, these three aspects can be applied effectively in learning material on changes in the form of objects. For example, when students learn the process of melting or evaporating through quiz games or visual simulations in *Educaplay*, they can connect new knowledge with everyday experiences, making learning more meaningful and helping to build deeper conceptual understanding.

Furthermore, *mindful learning* emphasizes the importance of students' awareness of the thinking process, feelings, and learning environment. In the context of learning using *Educaplay*, students can be actively engaged through reflective activities such as answering situation based questions or analyzing changes in the form of objects in real life scenarios. Thus, students not only understand concepts cognitively, but also develop social, emotional, and physical sensitivity to the scientific phenomena around them. Meanwhile, *joyful learning* plays a role in creating a fun and challenging learning atmosphere. The use of *Educaplay media* allows teachers to arrange interactive activities such as puzzles, image matching, or simulations of changes in the shape of objects that attract students' attention. This positive and encouraging learning environment fosters curiosity, increases motivation, and strengthens students' involvement in understanding science concepts in depth. With a feeling of pleasure and enthusiasm, students are more likely to internalize the concept of melting, evaporating, or condensing without feeling burdened by the learning process.

Overall, the use of Educaplay media combined with a deep learning approach aims to create a learning experience that is not only interactive, but also meaningful and transformative. Through a learning design that emphasizes elaboration, reflection, and connectivity between concepts, students are encouraged to build deep conceptual understanding and not simply memorize information. This media is also designed to stimulate, evaluating, constructing based arguments, which are crucial in addressing the complexity of scientific issues. Moreover, this approach helps students connect scientific knowledge to real-life contexts, enabling them to see the relevance of the material learned to the social, cultural, and technological environments around them. Thus, Educaplay acts as a 21st-century learning facilitator that supports the development of comprehensive scientific literacy. Through *meaningful learning*, *mindful learning*, and *joyful learning*, students not only understand the concept of changing the form of objects scientifically, but also are able to think critically, creatively, and reflectively. Thus, the use of *Educaplay* is a strategic means to grow a generation that is adaptive to the challenges of the 21st century and has the character of lifelong learners.

Teachers play a strategic role in integrating digital technology as part of active learning strategies oriented toward. Through an exploratory reflective approach, students are not only encouraged to understand concepts in depth but also trained to ask critical questions, evaluate information, and make decisions based on structured, logical reasoning. Digital technology, when used appropriately, can expand the learning space to be more dynamic and contextual, enabling students to interact with the material independently and collaboratively. Thus, the learning process shifts from simply memorizing or copying information to experiences that encourage knowledge construction, problem solving, and the strengthening of relevant critical thinking literacy. Students are really invited to understand what they are learning and discover its meaning for themselves through the experiences they have (Eshuis et al., 2022).

More broadly, also contribute to the development of 21st century learning innovations, where the use of technology and deep cognitive approaches are the main foundations in shaping a generation of critical, creative, and adaptive learners to change. The implementation of Educaplay with a Deep Learning approach can be used as an alternative to innovative learning strategies that not only improve learning outcomes, and foster critical and reflective thinking students'.

D. CONCLUSION

The use of Educaplay media with a Deep Learning approach in the learning process in the classroom can be used as a means to evaluate students in improving students' critical thinking skills on material changes in the form of objects and it is proven that the average score of students has increased from 55 to 83. In addition, based on calculations using the Sample t-test, a sig value of 0.000 < 0.05 was obtained, which means that there is an influence of the use of Educplay media with a Deep Learning approach on students' critical thinking skills. The existence of Educaplay media can also be used as a medium to train students to be able to apply digital literacy. Because the questions given in it have time so that students also practice reading quickly and interpreting what is meant by the questions. The existence of this research is expected to contribute to the world of education, especially in the use of digital learning media that is integrated with the Deep Learning approach that can create learning that is full of awareness, meaning, and fun. This research must have shortcomings, so that readers and researchers can develop Educaplay media not only with a Deep Learning approach and only on material on changing the form of objects, but can be done on other things. In addition, the use of Educaplay media can also be used not only to measure students' critical thinking skills, but can also be used for numeracy or other things.

ACKNOWLEDGMENTS
The researcher would like to thank Mr. Ahmad Syaifuddin as a teacher at MI Mambaul Ulum Dagan Lamongan who has helped and given permission regarding research activities, as well as related parties who have helped the completion of this research.

REFERENCES

Aiman, U., Hasyda, S., & Uslan, U. (2020). The Influence of Process Oriented Guided Inquiry Learning (POGIL) Model Assisted by Realia Media to Improve Scientific Literacy and Critical Thinking Skill of Primary School Students. *European Journal of Educational Research*, *9*(4), 1635–1647. https://doi.org/10.12973/eu-jer.9.4.1635

Akram, M., Zafar, J. M., Aziz, S., & Asghar, M. (2022). Elementary School Students' Conceptual Difficulties in the Subject of General Science: A Descriptive Study. *Pakistan Journal of Humanities and Social Sciences*, *10*(1), 43–49. https://doi.org/10.52131/pjhss.2022.1001.0172

Aktoprak, A., & Hursen, C. (2022). A Bibliometric and Content Analysis of Critical Thinking in Primary Education. *Thinking Skills and Creativity*, *44*(1). https://doi.org/10.1016/j.tsc.2022.101029

Arni, Y., Safitri, Y., Trisna, F., & Manurung, E. S. (2024). The Effect of Interactive Learning Media on Improving Students' Critical Thinking Skills. *ALACRITY: Journal of Education*, 49–58. https://doi.org/10.52121/alacrity.v4i1.226

Bal, M., & Öztürk, E. (2025). The potential of deep learning in improving K-12 students' writing skills: A systematic review. *British Educational Research Journal*, *51*(3), 1295–1312. https://doi.org/10.1002/berj.4120

Bali, M. M. E. I., Santoso, F., & Yuliana, R. (2020). Inovasi media pembelajaran dalam meningkatkan hasil belajar dan motivasi belajar siswa sekolah dasar. *Jurnal Pendidikan Dasar Nusantara*, *5*(1), 14–25.

Çavuş, E., İdil, Ş., & Dönmez, İ. (2025). Effects of a design-based research approach on fourth-grade students' critical thinking, problem-solving skills, computational thinking, and creativity self-efficacy. *International Journal of Technology and Design Education*. https://doi.org/10.1007/s10798-025-09989-8

Chen, X., Wang, X., Wang, Y., Liu, D., & Zhang, W. (2025). Leveraging deep learning and graph analysis for enhanced course recommendations in online education. *Scientific Reports*, *15*(1), 18623. https://doi.org/10.1038/s41598-025-02156-y

Chukwuemeka, E. J., & Garba, M. (2024). Technology as a catalyst for learning and unlearning: A tool for navigating education in a dynamic society. *European Journal of Interactive Multimedia and Education*, *5*(2), e02404. https://doi.org/10.30935/ejimed/15640

Ennis, R. (1991). *Critical Thinking: A Streamline Conception Robert Ennis*.

Eshuis, E. H., ter Vrugte, J., & de Jong, T. (2022). Supporting reflection to improve learning from self-generated concept maps. *Metacognition and Learning*, *17*(3), 691–713. https://doi.org/10.1007/s11409-022-09299-7

Feri, M., Ismiati, N., Al-Nur, W. R., & Akbar, F. N. (2025). Implementing Deep Learning Approaches in Primary Education: A Literature Review. *Jurnal VARIDIKA*, *37*(1), 178–194. https://doi.org/10.23917/varidika.v37i2.12151

Gazit, E., Yair, Y., & Chen, D. (2005). Emerging conceptual understanding of complex astronomical phenomena by using a virtual solar system. *Journal of Science Education and Technology*, *14*(5–6), 459–470.

Govindasamy, P., Cumming, T. M., & Abdullah, N. (2024). *Validity and reliability of a needs analysis questionnaire for the development of a creativity module*. 637–652. https://doi.org/10.1111/1471-3802.12659

Goyibova, N., Muslimov, N., Sabirova, G., Kadirova, N., & Samatova, B. (2025). Differentiation approach in education: Tailoring instruction for diverse learner needs. *MethodsX*, *14*, 103163. https://doi.org/https://doi.org/10.1016/j.mex.2025.103163

Hafeez, M. (2021). Systematic Review on Modern Learning Approaches, Critical Thinking Skills

and Students Learning Outcomes. *Indonesian Journal Of Educational Research and Review*, *4*(1), 167. https://doi.org/10.23887/ijerr.v4i1.33192

Kadbey, H., Dickson, M., & McMinn, M. (2015). Primary Teachers' Perceived Challenges in Teaching Science in Abu Dhabi Public Schools. *Procedia - Social and Behavioral Sciences*, *186*, 749–757. https://doi.org/10.1016/j.sbspro.2015.04.055

Kovač, V. B., Nome, D. Ø., Jensen, A. R., & Skreland, L. L. (2025). The why, what and how of deep learning: critical analysis and additional concerns. *Education Inquiry*, *16*(2), 237–253. https://doi.org/10.1080/20004508.2023.2194502

Kozanitis, A., & Nenciovici, L. (2023). Effect of active learning versus traditional lecturing on the learning achievement of college students in humanities and social sciences: a meta-analysis. *Higher Education*, *86*(6), 1377–1394. https://doi.org/10.1007/s10734-022-00977-8

Lu, Z., Chiu, M. M., Cui, Y., Mao, W., & Lei, H. (2023). Effects of Game-Based Learning on Students' Computational Thinking: A Meta-Analysis. *Journal of Educational Computing Research*, *61*(1), 235–256. https://doi.org/10.1177/07356331221100740

Mao, Weijie, Cui, Yunhuo, Chiu, Ming M, & Lei, Hao. (2021). Effects of Game-Based Learning on Students' Critical Thinking: A Meta-Analysis. *Journal of Educational Computing Research*, *59*(8), 1682–1708. https://doi.org/10.1177/07356331211007098

Mardiana, N., Hamdu, G., & Aprilia, R. (2020). Pengembangan media digital dalam meningkatkan literasi sains siswa sekolah dasar. *Jurnal Ilmiah Pendidikan Guru Sekolah Dasar*, *7*(1), 45–55.

Mukni'ah, M., Mudrikah, M., & Presbianti, Y. R. (2025). The development of game-based learning media by using educaplay to increase student motivation and participation. *Research and Development in Education (RaDEn)*, *5*(1 SE-Articles), 273–288. https://doi.org/10.22219/raden.v5i1.38809

Nadilah, P., Hakim, L., & Utomo, B. (2025). Efektivitas Media Educaplay Sebagai Game Edukasi Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Kelas V dalam Pembelajaran Tata Surya. *Edukasiana: Jurnal Inovasi Pendidikan*, *4*(4), 1528–1538. https://doi.org/10.56916/ejip.v4i4.1953

Nasution, S. S., & Dea, M. (2025). Analisis Kesulitan Siswa Memahami Konsep Materi Pembelajaran IPAS Kelas V SDN 17 Pekanbaru. *Jurnal Penelitian Ilmu Pendidikan Indonesia*, *4*(3), 1549–1554. https://doi.org/10.31004/jpion.v4i3.622

Ningrum, D. A. K., Ningrum, A. S. B., Indah, R. N., & Syaifulloh, B. (2025). Developing the Educaplay grammar assessment for tenth graders of senior high school in Kediri. *Jurnal Inovasi Teknologi Pendidikan*, *12*(1), 82–91. https://doi.org/10.21831/jitp.v12i1.79346

Nur'aeni, A. P., Harianingsih, Avrilianda, D., & Ellinawati. (2025). *Educaplay as an Interactive Digital Media for Students ' HOTS Thinking on Living Things Material A . Introduction*. *6*(3), 1857–1872. https://doi.org/https://doi.org/10.51276/edu.v6i3.1309

Nurhayati, N., Karlimah, K., & Hamdu, G. (2025). The Use of Educaplay in Primary School Learning. *Jurnal Cakrawala Pendas*, *11*(3), 557–567. https://doi.org/10.31949/jcp.v11i3.13451

Osterhaus, C., Koerber, S., & Sodian, B. (2017). Scientific thinking in elementary school: Children's social cognition and their epistemological understanding promote experimentation skills. *Developmental Psychology*, *53*(3), 450–462. https://doi.org/10.1037/dev0000260

Pan, Q., Zhou, J., Yang, D., Shi, D., Wang, D., Chen, X., & Liu, J. (2023). Mapping Knowledge Domain Analysis in Deep Learning Research of Global Education. In *Sustainability* (Vol. 15, Issue 4). https://doi.org/10.3390/su15043097

Ramadhani, A. (2025). Kendala dan Tantangan Pembelajaran IPA di UPT SD Negeri 064995 Kota Medan dalam Implementasi Kurikulum Merdeka. *Jurnal Penelitian Ilmu Pendidikan Indonesia*, *4*(2), 1150–1155. https://doi.org/10.31004/jpion.v4i2.547

Ramadhani, S., & Maulana, H. (2019). Analisis kesulitan belajar IPA pada siswa sekolah dasar ditinjau dari pendekatan konseptual. *Jurnal Pendidikan Dasar*, *10*(1), 33–41.

Saputra, A. R., Murti, R. C., & Hastuti, W. S. (2025). The Effect of Web-Based Interactive Learning Media on Critical Thinking Skills of Elementary School Students. *Jurnal Prima Edukasia*,

13(1), 159–168. https://doi.org/10.21831/jpe.v13i1.75228
Sudarmono, M. A., Hasan, & Halima. (2025). Deep Learning Approach in Improving Critical Thinking Skills of Elementary School Students. *Jurnal Penelitian Pendidikan IPA*, *11*(8), 60–70. https://doi.org/10.29303/jppipa.v11i8.11708
Yasa, A. D., Kumala, F. N., Wibawa, A. P., & Hidayah, L. (2023). Evaluation of Creative Thinking Skills in the Development of Elementary Science Learning in Elementary Schools: A Mix Method Study. *Journal of Education Research and Evaluation*, *7*(4), 559–568. https://doi.org/10.23887/jere.v7i4.68255