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Hybrid-Discovery Learning: Enhancing Critical Thinking Skills and Learning Outcomes in Science and Social Studies among Elementary Students

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Abstract: The objective of this research is to investigate the influence of Hybrid-Discovery Learning (Hybrid-DL) implementation on students' critical thinking abilities and performance. This study uses field research with a quantitative approach, and the Post-test Only Control-Group Quasi-Experiment method was employed. The study population comprised 54 fifth-grade students from Bayanul Azhar Bendiljati Kulon Sumbergempol Islamic Elementary School, divided into three classes: V-A (16 students), V-B (15 students), and V-C (23 students). Data collection instruments included learning outcome test sheets and critical thinking skills record tests. Data collection techniques used in this study were 1) Observation, researchers conducted observations of the learning process taking place at Bayanul Azhar Bendiljati Kulon Sumbergempol Islamic Elementary School; 2) Interview, researchers conducted interviews with teachers who teach science subjects to see the development of students' critical thinking after applying the Hybrid-Discovery learning model. The obtained data were analysed using a two-way MANOVA analysis, with a significance level of 5%. The research findings show that Hybrid-DL has a significant effect on the achievement of critical thinking skills and learning outcomes. This effect is demonstrated by the improvement in student learning outcomes in the form of learning motivation in the form of increased student enthusiasm for learning as evidenced by increased learning motivation questionnaire scores, and learning achievement as represented by increased student formative assessment scores in the form of report card grades, as well as increased student critical thinking skills as taken from improved critical thinking skills test results.
Keywords: Critical thinking, discovery learning, hybrid, learning outcomes

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A. Introduction

Elementary education plays a crucial role in equipping students with essential 21st-century competencies required to navigate the complexities of the digital era and Society 5.0 (Aulia & Ramadan, 2025; Jannah & Atmojo, 2022). Among these competencies, critical thinking skills stand out as a core requirement, enabling learners to analyze information, evaluate arguments, and make evidence-based decisions (Al-Shehri, 2020; Darnella et al., 2020). However, empirical observations indicate that students' critical thinking abilities remain relatively low due to learning practices dominated by rote memorization and limited inquiry-based activities (Chumdari et al., 2023; Setiadi &

Elmawati, 2019). Consequently, students struggle to understand information deeply, identify causal relationships, and solve complex problems, revealing a significant gap in the development of higher-order thinking skills.

In the context of science and social studies learning in elementary schools, learning outcomes have not reached optimal levels. Many students can recall facts but have difficulty applying concepts in new or real-world situations, demonstrating limited conceptual understanding (Amelia et al., 2025; Oditya et al., 2024). Classroom instruction remains largely teacher-centered, with minimal opportunities for experiments, investigation, or analytical reasoning (Al Jaberi et al., 2024; Pennings & Hollenstein, 2020; Wahyuni et al., 2021). Such conditions indicate that the learning process has yet to fully support the development of students' critical thinking skills, which are essential for understanding scientific and social phenomena logically, systematically, and reflectively.

Innovative learning models such as Discovery Learning offer solutions by promoting a constructivist approach in which students explore, investigate, and form conceptual understanding through guided discovery (Ayuningsih & Muna, 2023; Burhendi, 2019; Setiadi & Elmawati, 2019). This method has been widely recognized for its effectiveness in strengthening critical thinking and improving learning outcomes (Chusni, 2022; Hariawan et al., 2017; Khasanah et al., 2023). Additionally, the integration of hybrid learning, which combines offline and online modalities, is increasingly relevant in the digital era, providing wider access to learning resources, flexibility, and opportunities for personalized learning (Mu'amalah, 2024; Nadjamuddin et al., 2022; Zaini et al., 2023). Research consistently demonstrates that the combination of innovative models and digital platforms can significantly enhance higher-order thinking skills and deepen students' conceptual mastery.

Although numerous studies have examined critical thinking skills and the effectiveness of models such as Problem-Based Learning (Adawiyah, 2018; Endaryati et al., 2021), STEM (Chamorro-Atalaya et al., 2023), inquiry learning (Li & Arshad, 2015; Nasution & Nasution, 2023), RADEC (Sapitri et al., 2023; Yulianti et al., 2022), and cooperative learning (Harianto et al., 2020; Tambunan, 2021)Very few have specifically investigated the integration of Discovery Learning and hybrid learning within science and social studies contexts at the elementary school level. Most earlier research focused on isolated models or subject areas, without incorporating digital learning environments that are increasingly essential today. Therefore, this study fills an important research gap by offering a more comprehensive instructional approach that merges constructivist learning and digital integration to enhance critical thinking skills and student learning performance.

The purpose of this study is to analyze the effectiveness of hybrid Discovery Learning in enhancing elementary students' critical thinking skills. Critical thinking itself is an essential intellectual process that enables learners to evaluate information rationally, reflect on ideas, and monitor their cognitive processes (Ahman & Budiwati, 2025; Changwong et al., 2018; Zubaidah, 2016). Previous studies have demonstrated that students with strong critical thinking abilities are better able to analyze data, identify

assumptions, recognize cause-and-effect relationships, propose innovative solutions, and make well-reasoned decisions (Atikah et al., 2023; Firdaus et al., 2019; Shoffa, 2022). Therefore, this study highlights the urgent need to strengthen critical thinking through appropriate instructional models, particularly in the context of the Fourth Industrial Revolution 4.0 and Society 5.0, where high-level thinking skills are indispensable.

In addition to critical thinking, learning quality is also reflected in students' satisfaction and achievement levels (Chumdari et al., 2023; Suresmi et al., 2020). Thus, teachers must carefully select appropriate learning models to ensure that instruction is effective, efficient, and engaging. Prior research emphasizes that learning outcomes improve when instructional methods align with learners' needs and the nature of their subject matter (Nuryati, 2015; Puspitasari, 2024). Conversely, ineffective learning strategies can lead to poor performance and hinder the development of higher-order thinking skills. Therefore, enhancing the teaching–learning process through innovative models, such as hybrid-based Discovery Learning, is essential to helping students achieve learning goals and develop the critical thinking abilities required for future success.

B. Method

This research employs the Post-test Only Control-Group Quasi-Experiment (Mueller et al., 2024) method to investigate whether Hybrid-Discovery Learning influences the critical thinking skills and IPAS learning outcomes of elementary school pupils. It was conducted during the second term of the 2022/2023 academic year, from February to July 2023, at Bayanul Azhar Bendiljati Kulon Islamic Elementary School in Sumbergempol, Tulungagung Regency. There were two dependent variables: critical thinking skills and learning outcomes. The independent variable of this study was the Hybrid-Discovery Learning model. The information was presented in a logical structure, with citations following consistent formatting throughout. The text was grammatically correct, free of spelling and punctuation errors. The study population comprised 54 fifth-grade students from Bayanul Azhar Bendiljati Kulon Sumbergempol Islamic Elementary School, divided into three classes: V-A (16 students), V-B (15 students), and V-C (23 students).

Critical thinking skills were assessed using a test sheet developed by Ennis (Septiany et al., 2024). The sheet comprised five items, each categorized into low (1.00 - 2.00), medium (2.01 - 3.00), and high (3.01 - 4.00). Upon analyzing the instrument items, it could be concluded that all items were valid and that the instrument was reliable.

Data collection was conducted twice for each research parameter, both before (pre-test) and after (post-test) the introduction of independent variables in both classes (Creswell, 2014). To collect learning outcome data, a test sheet containing 10 essay questions was used. It should be noted that all students used the same instrument. To collect learning outcome data, a test sheet containing 10 essay questions was used (Caspersen et al., 2017). The instrument was tested on 23 respondents from Class V-C at Bayanul Azhar Bendiljati Kulon Sumbergempol Islamic Elementary School. Following evaluation of the instrument items, 10 items have been validated, placing the instrument

in the 'reliable' category. Data collection techniques used in this study, namely: 1) Observation, researchers conducted observations of the learning process taking place at Bayanul Azhar Bendiljati Kulon Sumbergempol Islamic Elementary School; 2) Interview (Seidman, 2006), researchers conducted interviews with teachers who teach science subjects to see the development of students' critical thinking after receiving the application of the Hybrid-Discovery learning model. Interviews were conducted with several teachers to find valid data. In addition, researchers conducted interviews with the madrasah principal to assess the science teacher's instruction.

This data analysis was gradual and occurred as the research progressed, with the results used to support the quantitative findings. This analysis model includes data condensation, data collection, drawing conclusions, and verifying the results of data analysis. Meanwhile, quantitative data is analyzed using quantitative analysis. The results were subjected to MANOVA analysis (Emerson, 2018). The interpretation was indicated by the multivariate statistical significance value (such as Wilks' Lambda, Pillai's Trace, or Hotelling's Trace), which was below the significance level ($\alpha = 0.05$).

C. Results and Discussion

Results

Data description begins with normality and homogeneity tests of the collected data. Table 1 displays the results of the Shapiro-Wilk and Levene tests analyzing the obtained data. According to Table 1, the statistical significance of the learning outcomes for critical thinking skills, as determined by the Shapiro-Wilk and Levene tests, is 0.056, 0.138, 0.890, and 0.275, respectively. Therefore, the data from this study satisfy the assumptions of normality and homogeneity.

Table 1. The Results of the Normality and Homogeneity Tests of the Research Data

Data	Statistical Tests	Sig.
Learning outcomes	Shapiro-Wilk	0.056
	Levene	0.890
Critical thinking skills	Shapiro-Wilk	0.138
	Levene	0.275

According to their hypothesis testing results presented in Table 2, their F value for the critical thinking ability parameter was 11.566, with a Sig. values of 0.002, which is less than 0.05. As a result, there is a notable difference in critical thinking performance between students in the experimental and control classes. Additionally, their parameter of learning outcomes obtained an F value of 8.196 with Sig. $0.008 < 0.05$. Thus, a notable disparity exists in academic performance between the experimental and control classes. This data highlights how students who undertook Hybrid-DL instruction demonstrated enhanced critical thinking abilities and superior learning outcomes compared to their peers in alternative classes.

Table 2. Their Results of the MANOVA Test of the Research Data

Data	Degree of Freedom	F	Sig.
Learning outcomes	1	11.566	< 0.05
Critical thinking skills	1	8.196	< 0.05

After conducting a MANOVA analysis, Table 3 presents the average critical thinking ability of students in the experimental and non-experimental classes.

Table 3. The Comparison of Mean Scores of Corrected Results from Experimental and Control Classes

Data	Classes	Pretest	Posttest	Increase (%)	Corrected Mean Scores
Learning outcomes	Experiment	53.760	79.330	47.610	80.720
	Control	54.070	68.750	27.140	69.000
Critical thinking skills	Experiment	57.920	79.000	36.390	80.020
	Control	58.300	67.60	15.950	68.000

Their results showed the effectiveness of Hybrid-DL learning implementation on critical thinking skills. Based on their MANOVA results (Table 2), the F value for the critical thinking skills variable is 8.196, with Sig. value < 0,05. Thus, the development of students' critical thinking skills in Hybrid-DL learning was significantly different from that of students who did not learn. Furthermore, based on the data analysis presented in Table 3, the average corrected score for students' critical thinking skills in the experimental class (80.020) is higher than that in the control class (68.000). This, based on the MANOVA test results and the average corrected score, indicates that students who received Hybrid-DL learning achieved much higher levels of creative thinking skills than those who did not.

Based on closed-door interviews with several respondents at Uingguilan Bayanuil Azhar Beindiljati Kuilon Suimbeirgeimpol Islamic Elementary School, supporting data were collected to inform the quantitative test results. Their class teacher stated that implementing hybrid learning made students more critical because their learning activities train them to continuously hone their thinking and reasoning skills. A similar statement was made by the Islamic Religious Education teacher, who stated that during the learning process, students demonstrate improved critical thinking skills. However, some students still had not fully mastered their material. Meanwhile, the principal emphasized that critical thinking skills could be trained, such as through hybrid learning. According to him, this learning model encourages students to be more active and to display critical thinking. Field observations also supported these findings, showing that hybrid learning improved students' critical thinking skills, as evidenced by increased formative test scores.

Discussion

The impact of the Hybrid-DL app on students' creative thinking skills aligns with numerous previous studies that have investigated the effects of Discovery Learning and Hybrid Learning on thinking abilities. The Discovery Learning Model can enhance

students' critical thinking skills (Chusni, 2022; Nasution & Nasution, 2023). It aligns with previous research (Burhendi, 2019; Nurlaili et al., 2021) that proposes that Hybrid-DL offers opportunities to enhance students' thinking skills. Additional studies suggest that Hybrid-DL could foster the development of three key components of thinking skills: self-regulation, critical thinking, and creative thinking (Nadjamuddin et al., 2022; Paryanti & Nofiana, 2023). It is in line with Setiadi and Elmawati's (2019) research, which indicates that the use of the discovery learning model can prompt active, process-driven, self-directed, and reflective learning among students.

Hybrid learning is an educational model that combines traditional face-to-face classroom instruction with online learning elements. This approach leverages the strengths of both methods to create a more flexible and personalized learning experience. Table 4 below describes some key aspects of hybrid learning.

Table 4. Key aspects of hybrid learning

No.	Key aspect	Description
1.	Blended Learning Environment	Students attend some classes in person while completing their coursework online. It can take various forms, such as online lectures, discussion forums, or interactive modules (Dewi & Fatkhiyani, 2021).
2.	Flexibility and Accessibility	Hybrid learning allows students to choose how and when to engage with learning materials. It can accommodate different learning paces and styles, making education more accessible (Ott et al., 2018).
3.	Personalized Learning	Their model supports tailored educational experiences where students can focus on areas where they need more help or explore subjects that interest them in greater depth.
4.	Technology Integration	Successful hybrid learning relies heavily on technology, including learning management systems (LMS) like Moodle or Blackboard, video conferencing tools like Zoom, and interactive software that fosters engagement.
5.	Active Learning	In hybrid settings, students often engage in active, hands-on learning activities, both online and offline, which encourage critical thinking and collaboration (Mahmudi et al., 2022).
6.	Assessment Diversity	Hybrid learning allows for a range of assessment strategies, combining traditional tests with online quizzes, discussions, or projects that measure understanding in different ways (Hsbollah & Hassan, 2022).

In addition, what must be included in hybrid learning are (1) Constructivism, (2) Connectivism, and 3) Community of Inquiry. Constructivism emphasizes the importance of students constructing their own understanding and knowledge of the world through

experience and reflecting on those experiences (Braun & Hughes, 2019). This theory supports interactive and collaborative (Awang-Hashim et al., 2023; Özdemir, 2019) aspects of hybrid learning. Meanwhile, Connectivism refers to a theory that posits learning occurs across a network of information and emphasizes the importance of digital literacy (Adha et al., 2022; Kaeophanuek et al., 2018) and understanding as part of the hybrid model, acknowledging the role of social networking in modern education. Finally, Community of Inquiry focuses on creating a meaningful educational experience through social, cognitive, and teaching presence(Lidor et al., 2024; Lopes & Vieira, 2018). This theory aligns well with the hybrid format, where online interactions must be purposefully designed to foster learning.

Hybrid learning is a dynamic approach that accommodates various teaching and learning styles while leveraging technology to enhance education. It can offer significant benefits, but successful implementation depends on careful consideration of student needs, access to technology, and effective instructional strategies if one is interested in a specific aspect of hybrid learning or its application in a particular context.

Similar to the learning outcome parameter, one reason for students in the experimental class having superior critical thinking skills compared to those in the control class was that they engaged in problem-solving, discovery, and revelation learning activities. Such activities challenged their students to flex their creative muscles in devising solutions to sustain their environment's ecosystems and food webs, thereby averting extinction. Students in their experimental class must apply their knowledge and skills to generate solutions and concrete steps for resolving the provided issues. This explanation is consistent with other studies (Khasanah et al., 2023; Paryanti & Nofiana, 2023; Santana et al., 2023; Sulistyanto et al., 2023), suggesting that incorporating problem-solving and discovery activities can revolutionize the learning process by cultivating students' critical thinking abilities to comprehend concepts, meanings, and relationships through an intuitive approach, ultimately leading to the identification of key principles and ideas. Furthermore, comparable accounts are provided by Liu and Ke (2007) as well as Santana et al. (2023), who asserts that discovery-based learning tasks necessitate students to creatively generate solutions to problems through producing a tangible output.

Their results show the effectiveness of Hybrid-DL learning implementation on learning outcomes. Thus, the learning outcomes of students who received Hybrid-DL learning were significantly different from those of students who did not. This increase in learning outcomes is also proven by the results of interviews with teachers at the Bayanuil Azhar Beindiljati Kuilon Suimbeirgeimpol Islamic Elementary School, who stated: "students have high motivation since the implementation of hybrid learning, as students have become able to utilize technology in daily learning activities. The head of their school also said that "student achievement in all subjects has increased due to the impact of their implementation of hybrid learning. Their observations also indicated that student learning achievement has increased, as evidenced by higher formative test scores.

Based on their teachers' statements, the head of the madrasah, and their observations, it can be concluded that learning outcomes have improved through hybrid learning. These learning outcomes are structured into learning motivation and learning achievement. Their study's findings, which demonstrate the impact of implementing Hybrid DL on student learning outcomes, align with earlier reports examining nearly identical learning designs. Several studies (Andira et al., 2018; Jaya & Sucipto, 2023; Syazali et al., 2023; Virera et al., 2025) support their notion that a Hybrid application has a beneficial effect on students' learning outcomes. Additionally, others (Anisa & Astriani, 2022; Ekaputra, 2023; Setianingrum & Wardani, 2018) have argued that discovery learning can help students achieve optimal significant learning, leading to better results.

Expert opinions on the benefits of hybrid learning mirror the benefits discussed above. Table 5 lists some expert views highlighting the benefits of hybrid learning. From these views, it is clear that many experts agree that hybrid learning offers advantages that can enrich students' learning experiences, improve academic outcomes, and prepare students for future challenges.

In this study, their learning outcomes depict their students' grasp of concepts. The experimental class exhibited superior concept mastery due to Hybrid-DL's ability to promote meaningful learning (Pramesti et al., 2022). Specifically, problem-solving and discovery activities enable students to experience such learning conditions. This study aims to address the issue of maintaining interconnectivity between ecosystems and food webs in students' environments to prevent extinction. As a result, the experimental class provided students with meaningful learning experiences through problem-solving activities and real-life discoveries, promoting a better understanding of everyday conditions (Fauziana & Fazilla, 2022; Pranoto et al., 2017). This discovery learning model's primary characteristic is this activity (Abdullah et al., 2020; Chusni, 2022; Ekaputra, 2023).

In addition to receiving meaningful instruction, students in the experimental class were also encouraged to become active learners. Through problem-solving and discovery activities, they were prompted to actively reflect on their knowledge and cultivate collaboration within groups. Collaborative activities aimed at problem-solving through exploration and experimentation have been found to facilitate active learning among students (Awang-Hashim et al., 2023; Dewi & Muhid, 2021; Donlon et al., 2020; Endrawan & Aliriad, 2023; Sotto, 2021). Additionally, these collaborative activities have been reported to enhance the absorption of knowledge during the learning process (C. A. Dewi, 2021; Laal & Laal, 2012; Rodphotong, 2018; Roth & Roychoudhury, 1993; Simonin, 1997; W. Zhang et al., 2021). Additionally, other research has shown that Hybrid-DL enables students to acquire knowledge through exploration, experimentation, and practical experience. Consequently, learners are encouraged to actively engage with concepts and information to enhance their understanding and critical thinking abilities.

Table 5. Experts' opinions regarding the benefits of hybrid learning

No.	Name	Occupation	Note
1.	Tony Bates	distance education expert	Bates states that hybrid learning offers greater flexibility and accessibility for students. He emphasizes the importance of combining online and face-to-face learning to cater to different learning styles, thereby increasing student engagement (Alrabah et al., 2018).
2.	Barbara Schneider	Education expert	Schneider emphasizes that hybrid learning can improve student academic achievement. By providing access to online resources and time for face-to-face interaction, students are able to better understand the material and apply the knowledge they have gained (Leasa et al., 2023).
3.	Phil Hill	education consultant	Hill originally recommended hybrid learning as an effective solution to learning educational technology. He argues that this model allows institutions to tailor teaching methods to students' needs and enhances the overall learning experience (Shahrill et al., 2013).
4.	Linda Harasim	online education researcher	Harasim notes that hybrid learning not only combines face-to-face and online learning but also encourages collaboration and communication between students. This is essential in building a strong learning community and developing students' social skills (Mufidah, 2024).
5.	Richard Felder	engineering education expert	Fielder emphasized that hybrid learning provides multiple ways to deliver and receive information. He believes that this variety of methods can help in capturing students' attention and enhancing their understanding (Hatt et al., 2024).
6.	Eric Mazur	physics and education expert	Mazur, renowned for his active learning methods, argues that hybrid learning encourages students to develop independent learning skills. Students are taught to take responsibility for their own learning, which helps them become lifelong learners (Lidor et al., 2024).

Continued Table 5.

No.	Name	Occupation	Note
7.	Charles Graham	education researcher	Graham pointed out that hybrid learning allows for more efficient use of time, with students being able to spend more time interacting and collaborating in class, while basic concepts can be learned through online materials (Afify, 2018).

D. Conclusion

Hybrid-DL significantly affects their achievement of critical thinking skills and learning outcomes. This influence is indicated by the increase in student learning outcomes in the form of learning motivation, in the form of increased student engagement for learning, represented by Maslow's theory, and learning achievement, represented by increased student formative assessment scores, as well as increased student critical thinking skills. This study shows that Hybrid-DL offers a viable alternative to conventional learning methods, aligning with the requirements of the 21st century.

Their evidence supports implementing this model across multiple schools within Indonesia. It is recommended that training or dissemination programs be implemented to ensure that IPAS teachers become familiar with its benefits. Additionally, it is necessary to conduct further investigation into their level of empowerment of critical thinking skills between Hybrid-DL and alternative learning models. This research will provide insight into the benefits and drawbacks of Hybrid-DL compared to other learning models. Additionally, their studies should investigate the impact of Hybrid-DL on other cognitive abilities to provide educators with a comprehensive understanding of the benefits of using the Hybrid-DL model in their educational settings. Future research should also focus on evaluating Hybrid-DL implementation on its parameters to more thoroughly demonstrate the approach's positive impact. It is also advisable to extend the duration of their study, thus enabling the long-term effects of Hybrid-DL to inform practical solutions for addressing their issues related to cognitive abilities and educational achievements.

Their findings indicate that Hybrid-Discovery Learning is an effective instructional approach for simultaneously enhancing critical thinking skills and learning outcomes in elementary science and social studies. Pedagogically, this model supports a shift toward student-centered and inquiry-based learning, encouraging active exploration, problem-solving, and reflective thinking.

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