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THE APPLICATION OF THE FLASHCARD-ASSISTED GROUP INVESTIGATION MODEL ON ELEMENTARY SCHOOL STUDENTS' CRITICAL THINKING SKILLS IN SCIENCE

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Abstract

Given the increasingly complex challenges in the world of education, students' critical thinking skills have become a key issue that requires attention. Currently, students' critical thinking skills remain relatively low, largely due to unengaging teaching methods where students focus solely on textbooks and the delivery of material, causing them to become bored more quickly during the learning process. The Group Investigation (GI) model supported by Flashcard media can serve as a solution to enhance these skills, as the learning process encourages students to be more active in identifying and analyzing problems. The objective of this study is to present the Group Investigation (GI) model supported by Flashcard media as an interactive model and medium for learning activities in Grade 5 at SDN Pasawahan Anyar. This study was conducted using a quasi-experimental method through a descriptive quantitative approach. The results of the study indicate that the implementation of the Group Investigation (GI) model, supported by flashcards, has a significant positive effect of 60.1% on students' critical thinking skills in science. It was also observed that the improvement achieved through the Group Investigation (GI) model supported by flashcards was superior to that of the Think Pair Share learning model. Theoretically, this

study supports the application of constructivist and collaborative learning approaches in developing students' critical thinking skills. In practice, the findings of this study can serve as an alternative for teachers in creating active and interactive science lessons using the Group Investigation model aided by flashcards.

Keywords: Group Investigation, Flashcards, Critical Thinking

Abstrak

Melihat tantangan di dunia pendidikan yang semakin kompleks, kemampuan berpikir kritis siswa menjadi salah satu permasalahan yang perlu diperhatikan. Saat ini, tingkat kemampuan berpikir kritis siswa masih tergolong rendah, hal ini disebabkan oleh pembelajaran yang kurang menarik dimana siswa hanya berfokus pada buku dan penyampaian materi, sehingga siswa lebih cepat merasa bosan selama proses pembelajaran. Model *Group Investigation* (GI) berbantuan media *Flashcard* dapat menjadi solusi untuk meningkatkan kemampuan tersebut, karena pada proses pembelajarannya menjadikan siswa lebih aktif dalam mengidentifikasi dan menganalisis suatu permasalahan. Tujuan dari penelitian ini adalah memaparkan model *Group Investigation* (GI) berbantuan media *Flashcard* sebagai model dan media yang bersifat interaktif dalam kegiatan pembelajaran di kelas V SDN Pasawahan Anyar. Penelitian ini dilakukan menggunakan metode quasi eksperimen melalui pendekatan kuantitatif deskriptif. Dari hasil penelitian dapat diketahui bahwa penerapan model *Group Investigation* (GI) berbantuan media *Flashcard* memiliki pengaruh positif terhadap kemampuan berpikir kritis IPA siswa secara signifikan. Terlihat juga bahwa peningkatan yang terjadi pada model *Group Investigation* (GI) berbantuan media *Flashcard* ini lebih baik dibandingkan dengan model pembelajaran *Think Pair Share.* Secara teoretis, penelitian ini memperkuat penerapan pembelajaran konstruktivistik dan kolaboratif dalam mengembangkan kemampuan berpikir kritis siswa. Secara praktis, hasil penelitian ini dapat menjadi alternatif bagi guru dalam menciptakan pembelajaran IPA yang aktif dan interaktif melalui model Group Investigation berbantuan media Flashcard.

Kata kunci: *Group Investigation*, *Flashcard*, Berpikir Kritis

INTRODUCTION

Education is the cornerstone of human development. Therefore, every individual must receive an education, as it plays a vital role in fostering the development of human potential and ensuring the continuity of human life. This aligns with the view of Nurhayati, et al (2022), who state that "Education is one of the key factors in human life, as it enables individuals to develop their inherent potential and become high-quality individuals." The importance of education for every human being means that education is also vital for students, particularly elementary school students. Elementary school students are the individuals who will drive the nation's progress. To shape students into high-quality individuals, education—specifically the implementation of learning—is essential.

Learning is a crucial process in the development of students' knowledge. Currently, learning focuses on 21st-century learning, which is expected to enhance knowledge. 21st-century learning requires students to possess critical thinking skills as a key characteristic to enable them to solve problems (Syahputra, 2024). This indicates that one of the essential skills students need to face future challenges—both in educational settings and daily life—is

critical thinking.

Critical thinking is a higher-order thinking skill through which students are able to observe, analyze, and find solutions to problems. This aligns with Facione (2015), who states that critical thinking is a higher-order cognitive skill encompassing interpretation, analysis, inference, evaluation, explanation, and self-regulation. Critical thinking skills are essential for students; beyond solving problems and overcoming challenges, they help students develop their own potential. According to Kusuma, et al (2024) critical thinking skills at the elementary school level have a positive impact on improving educational quality and serve as valuable preparation for students' future. These critical thinking skills can help students think clearly, rationally, and reflectively when dealing with complex problems. Furthermore, possessing these critical thinking skills will shape students into individuals capable of expressing their opinions when explaining a specific topic and then drawing conclusions based on the evidence gathered (Andriani & Anwar, 2023). Based on several opinions, it is evident that critical thinking skills are essential for students to possess.

Recognizing the importance of critical thinking skills for students, the Indonesian government has incorporated critical thinking into the curriculum, integrating it into the graduate profile. This is stipulated in Regulation of the Minister of Primary and Secondary Education of the Republic of Indonesia No. 10 of 2025 (Akbar, et al., 2025) regarding graduate competency standards, which states that the 8 Dimensions of the Graduate Profile must be mastered by the end of each level of education. These eight dimensions include faith and piety toward God Almighty, citizenship, critical reasoning, creativity, collaboration, independence, health, and communication. Therefore, students should possess critical thinking skills, as these skills play a vital role in their lives.

However, in reality, students' critical thinking skills remain relatively low (Anisa et al., 2021; Kafiar et al., 2023; Lorita et al., 2025; Rofi'ah & Rokhmaniyah, 2024; Wati et al., 2024). Based on the results of the Trends in International Mathematics and Science Study (TIMSS) in 1999, 2013, 2007, 2011, and 2015 (as cited in Rofi'ah & Rokhmaniyah, 2024) Indonesia is listed as one of the countries with low levels of critical thinking ability. The science scores obtained were consistently below the average of 397, and Indonesia ranked 44th out of 49 countries (Hadi & Novaliyosi (in Pramita et al., 2025). Furthermore, looking at data from the 2022 PISA results in the science category, which included 81 countries, Indonesia ranked 67th. This relatively low level of critical thinking ability is attributed to a learning process that fails to effectively develop students' critical thinking skills (Kafiar et al., 2023). This situation stems from students' tendency to merely passively receive instructional content without engaging in further analysis, resulting in a lack of deep understanding of the material (Amalia et al., 2021). In practice, teaching still relies on conventional methods and does not utilize interactive models or media; instruction focuses solely on textbooks, centers on the delivery of content, and tends to encourage students to memorize, resulting in students becoming easily bored, passive, and lacking creativity in the learning process (Goni & Geor, 2024; Rofi'ah & Rokhmaniyah, 2024).

Low levels of creativity can hinder students' efforts to generate ideas and alternative solutions. As a result, the process of analyzing, evaluating, and selecting the most appropriate idea becomes less effective, which can lead to poor critical thinking skills among students (Kembaren & Rusilowati, 2025).

Based on the issues described above, a solution is needed to address these problems by selecting appropriate learning models and media, thereby improving students' critical thinking skills. The learning model believed to be capable of enhancing critical thinking skills in elementary school students' science learning is the Group Investigation (GI) model. This aligns with Goni & Geor (2024), Lorita et al. (2025), and Rohmah et al. (2024) who state that the Group Investigation model can improve students' critical thinking skills. The Group Investigation (GI) model is a learning approach that facilitates collaboration between high-ability and low-ability students to work together in solving problems (Agus, as cited in Purba et al., 2024). Furthermore, this learning model is student-centered, where students exchange ideas regarding problems and solutions, thereby making students active and creative (Lorita et al., 2025). Thus, the Group Investigation (GI) model is highly suitable for use in learning due to the optimal and meaningful discussions among students and between students and teachers in the classroom. Through this learning approach, students' ability to construct and enhance their critical thinking skills is expected to improve. Based on this, it can be concluded that the Group Investigation (GI) model is a learning model that can enhance students' critical thinking skills in science education.

The application of the Group Investigation (GI) model is consistent with the theory of social constructivism proposed by Vygotsky, which holds that knowledge is constructed through social interaction, cooperation, and the exchange of ideas with others. In GI-based learning, students work in groups to identify problems, gather information, discuss them, and develop solutions. This process provides students with the opportunity to build and expand their knowledge through learning experiences with peers and under the guidance of teachers. Thus, discussion and investigation activities in the Group Investigation (GI) model can foster active, meaningful, and student-centered learning. Based on this, the Group Investigation (GI) model is a relevant approach to use in science education to help students construct knowledge while developing critical thinking skills through collaborative activities and problem-solving.

Furthermore, to make learning activities more enjoyable, the use of varied, interactive learning media that can enhance students' critical thinking skills is essential when implementing the Group Investigation (GI) model in the learning process. Wulandari, et al (2023) state that "Learning media are tools that teachers can use to convey information to students in a way that is easy to understand." In learning, media can be used as a tool to help teachers explain information to students more easily; with this assistance, students will think more deeply and become more engaged in learning activities. Therefore, learning media that align with the learning objectives and desired outcomes are necessary. One type of learning media that can be utilized as an effort to enhance students' critical thinking skills in 5th-grade Science learning is the use of flashcards.

Flashcards are double-sided cards featuring images and containing brief information (Kurniawati & Mawardi, 2023). This teaching tool is considered effective at capturing students' attention—especially that of young children—because it presents a variety of images and concise information. In addition to capturing attention, the use of flashcards is also aligned with the cognitive development characteristics of elementary school students aged 10–11 years. At this age, students still need visual aids in the form of concrete or semi-concrete materials to help them understand abstract concepts, particularly in science education. The images and brief information on the flashcards serve as a support system that helps students connect visual representations with scientific concepts, thereby making the

process of reasoning and conceptual understanding easier. Thus, flashcards not only serve as a tool to make learning more engaging, but also gradually support the development of students' scientific thinking skills and abstract reasoning. Based on the findings of a study conducted by Widahyanti, et al (2022), the use of flashcards has a significant effect on students' critical thinking skills, as evidenced by improvements in their comprehension and problem-solving abilities before and after the implementation of flashcards as a teaching tool. The findings indicate that the effectiveness of flashcards is not only based on their ability to present information in an engaging way, but also because this medium provides visual support that is appropriate for students' cognitive development stages, thereby facilitating the critical thinking process. Therefore, the use of flashcards is expected to be an effective alternative learning tool for improving the critical thinking skills of elementary school students.

Based on the results of previous research, the researcher was interested in conducting a study titled "The Effect of Implementing the Group Investigation (GI) Model with Flashcards on Elementary School Students' Critical Thinking Skills in Science", by using material on food chains, since this material requires students to understand the relationships among living things in an ecosystem and to analyze the interconnections between organisms, making it suitable for developing students' critical thinking skills.

METHODS

This study employs a quasi-experimental method with a descriptive quantitative approach. Yusuf (as cited in Syahrizal & Jailani, 2023) explained that the quantitative approach views human behavior as predictable and social reality as objective and measurable. This study employs a quasi-experimental method, involving a control group and a comparison group to compare the results of the treatment administered (Prayono, as cited in Syahrizal & Jailani, 2023). Through this approach, the researcher can gain a deeper understanding of the issue under investigation, namely critical thinking skills. Data collection in this study was facilitated using SPSS version 26.

RESULTS AND DISCUSSION

RESULTS

An analysis of pre-test and post-test data on the critical thinking skills of fifth-grade students at SDN Pasawahan Anyar in science classes indicates an overall improvement.

Table 1. Pre-test and Post-test Data for the Experimental Class and Control Class

Class	Type of Test	Score		*Mean*	*Sd*
		Min	Max		
Experiment	*Pre-test*	37	67	56,20	7,938
Experiment	*Post-test*	67	96	81,85	8,881
Control	*Pre-test*	37	67	50,95	8,757
Control	*Post-test*	50	71	61,10	7,011

Table 1 shows that before the intervention, the average critical thinking ability of students in the experimental class was 56.20, while that of the control class was 50.95. After the treatment using the Group Investigation (GI) model assisted by Flashcards, the average

post-test score for the experimental class increased to 81.85, while that of the control class using the Think Pair Share (TPS) model was 61.10.

After analyzing the averages, hypothesis testing was necessary. However, before hypothesis testing was conducted, the data was first analyzed through prerequisite tests, including normality and homogeneity tests.

Based on the results of the normality test data analysis, it was shown that the data in both the experimental and control classes were normally distributed, with a Sig. value of 0.084 in the experimental class and a Sig. value of 0.987 in the control class. It can therefore be concluded that the data in the experimental and control classes were normally distributed, since the Sig. value was > 0.05. The following are the results of the normality test.

Table 2. Results of the Normality Test for Improvements in Critical Thinking Skills in Science

Class	*Shapiro-Wilk*			Decision
	Statistic	***Df***	***Sig.***	
Experiment	0,916	20	0,084	H_0 is accepted (normal)
Control	0,986	20	0,987	H_0 is accepted (normal)

Next, below are the results of the homogeneity test obtained from the scores of the experimental and control classes:

Table 3. Results of the Homogeneity Test for Improvements in Critical Thinking Skills in Science

Data	Sig.	Decision
Experimental Group and Control Group	0,798	H_0 is accepted

Table 3 shows that the significance level (Sig.) for both the experimental and control classes is 0.798, which is greater than 0.05; therefore, the data from both classes have the same variance.

Subsequently, after conducting tests for normality and homogeneity of the data, hypothesis testing was performed using simple linear regression to determine the effect of the Group Investigation (GI) model aided by flashcards on elementary school students' critical thinking skills in science. The results of the simple linear regression test are presented in Table 4:

Table 4. Results of the Simple Linear Regression Equation

	Coefficients	
	Unstandardized B	***Std. Error***
Constant	33,095	9,447
(X)	0,868	0,167

Table 4 shows that the results of the simple linear regression indicate Y = 33.095 + 0.868X. This indicates that the constant (α) is 33.095 and the regression coefficient (β) is 0.868, which is also positive. Thus, the use of the Group Investigation (GI) model assisted by Flashcards has a positive effect on elementary school students' critical thinking skills in

science of 0.868, or equivalent to 86.8%. Furthermore, when the effect is examined through the regression significance test, it is observed that Sig. < 0.05; thus, it can be concluded that the Group Investigation (GI) model assisted by flashcards has an effect on the critical thinking skills in science of elementary school students. The following are the results of the regression significance test:

Table 5. Results of the Regression Significance Test

Test	***Sig.***	***α***	**Description**
Regression	< 0,000	0,05	Influential

After a significant effect was identified through a simple linear regression test, the analysis continued with the coefficient of determination to determine the extent to which the learning model contributed to the improvement of students' critical thinking skills.

Table 6. Results of the Coefficient of Determination Test

R	**R *Square***	***Std. Error of the Estimate***
0,775[a]	0,601	5,762

Table 6 shows that the coefficient of determination (R^2) was 0.601, indicating that the use of the Group Investigation (GI) model supplemented with flashcards had a significant effect on elementary school students' critical thinking skills in science, accounting for 60.1% of the variance, while the remaining 39.9% was attributed to other factors outside the scope of this study.

Furthermore, to determine the difference in the improvement of critical thinking skills between the experimental and control classes, an independent sample t-test was conducted on the N-Gain scores of both groups. The following are the results of the independent sample t-test:

Table 7. Results of the Independent Samples t-Test on the Improvement of Critical Thinking Skills in Science

Class	**(Sig.)**	**Interpretation**
Experiment Control	< 0.000	H_1 accepted

The results of the independent samples t-test showed a significance level (Sig.) of < 0.000, indicating a significant difference in the critical thinking skills in science between the experimental and control groups. Thus, the use of the Group Investigation (GI) model aided by flashcards proved to be more effective than the Think Pair Share (TPS) model.

To reinforce the test results, an N-Gain analysis was conducted to determine the improvement in students' critical thinking skills in each group. The following are the N-Gain calculation results.

Table 8. Results of the Descriptive Statistics Test for N-Gain

Class	*N-Gain Score*		$\bar{x}$	*N-Gain* (%)	*N-Gain* Criteria	Interpretation
	Min	Max				
Experiment	39	89	0,600	60%	Currently	Quite effective
Control	-19,05	54	0,190	19%	Low	Ineffective

Based on the N-Gain calculations, it appears that the N-Gain scores in the experimental class were higher than those in the control class. This indicates that the improvement in science critical thinking skills among students who used the Group Investigation (GI) model supplemented by flashcards was greater than that of students who used the Think-Pair-Share (TPS) model.

DISCUSSION

The Effect of Group Investigation (GI) Learning Assisted by Flashcards on Critical Thinking Skills in Science

Learning using the Group Investigation (GI) model supplemented with flashcards has an impact on students' critical thinking skills. This is due to the stages of the Group Investigation (GI) model supplemented with flashcards, namely identifying topics and organizing students into learning groups, planning learning tasks, conducting investigations, preparing final reports, presenting final reports, and evaluating, as this learning approach encourages students to actively identify problems, analyze materials, collaborate in groups, and exchange ideas to solve problems.

According to Kusuma, et al (2024), critical thinking skills include analyzing or identifying problems; thus, when students can identify a topic, they will be able to understand the problem in depth and make decisions based on relevant information. In addition, group activities are another way to improve critical thinking skills because they foster social interaction and problem-solving (Zaenab et al., 2022). Then, planning learning tasks, as explained by Sukmawati, et al (2025), this stage provides students with the opportunity to hone their ability to analyze, evaluate, and solve problems, which ultimately becomes the primary foundation for the development of their critical thinking skills.

Not only that, but during the investigation phase of the learning process, it was observed that students actively sought information, collected data, analyzed, and compared their findings with the help of flashcards. These investigative activities encourage students to think more logically, systematically, and reflectively when solving problems, thereby significantly enhancing their critical thinking skills. This is supported by research by Sitorus, et al (2025), which indicates that the use of flashcards in elementary school instruction has a positive impact on improving students' critical thinking skills. This is followed by a presentation activity where students present their results in a coherent manner and defend their answers based on the data obtained. This strengthens students' logical communication, argumentation, and response skills in learning, thereby enhancing their critical thinking abilities (Sulistianingsih & Sidoarjo, 2021). The final stage is evaluation, in line with the view of Utaminingsih, et al (2024) that evaluation significantly contributes to the improvement of students' critical thinking skills through the reinforcement of analysis and problem-solving. Through group activities involving investigation, discussion, and evaluation, students are trained to think logically and systematically, as well as to com

municate their opinions and draw conclusions objectively, thereby significantly improving their critical thinking skills.

Furthermore, this is also demonstrated by the results of the simple linear regression test, with a coefficient of determination (R^2) of 0.601, indicating that the use of the Group Investigation (GI) model supplemented with flashcards has a significant impact on elementary school students' critical thinking skills in science, accounting for 60.1% of the variation. This aligns with the opinion of Herdayanti, et al (2024) that the use of the Group Investigation (GI) cooperative learning model has a positive influence on improving students' critical thinking skills. However, in this study, 39.9% of the influence still came from other factors that could either enhance or hinder the achievement of students' critical thinking skills in science, due to the fact that the model and media were not commonly used in daily learning, as well as a lack of time to conduct the research.

Improving the Critical Thinking Skills in Science of Elementary School Students Through the Application of the Group Investigation (GI) Model Using Flashcards

Based on the research results, it was found that the average pre-test score in the experimental class was 56.20, while that in the control class was 50.95. As shown in the table of averages presented above, the level of critical thinking ability in both classes was relatively equivalent before the intervention was administered. After the intervention, both the experimental and control classes showed that the average post-test score for the experimental class was 81.85, while that for the control class was 61.10.

This improvement was observed across all indicators of critical thinking skills, including interpretation, analysis, evaluation, inference, explanation, and self-reflection. The highest N-Gain scores were found in the data interpretation indicator, which is characterized by students' ability to read and understand data related to the decline of a population and explain its consequences. The improvement in science critical thinking skills was influenced by the active role of teachers in providing explanations when drawing conclusions, in line with the opinion of Risandy, et al (2024), who emphasized that teachers play a crucial role as facilitators in learning by explaining the material and providing engaging and appropriate media, thereby helping students understand the material more easily, effectively, and meaningfully. Furthermore, student engagement in working on worksheets in groups with the aid of flashcards encourages students to actively analyze, solve problems, and understand concepts more deeply (Wulansari et al., 2024). Additionally, the implementation of discussions and presentations is essential because science material involves concepts, principles, laws, and theories, which require deeper reasoning; thus, the process of exchanging opinions (discussions) with teachers and peers is highly necessary (Marwati, 2022). Furthermore, continuous practice with exercises can help students assess their ability to solve problems. Thus, repeated practice with sample questions helps students gain a better understanding (Pratama et al., 2022). These various activities are supported by research findings indicating that teacher guidance, the use of interactive learning media, the Group Investigation model, and structured assessment significantly contribute to improving the critical thinking skills of elementary school students.

In the control class, the learning process was implemented using the Think Pair Share (TPS) model, which consists of three main stages: Think, Pair, and Share, with the same critical thinking indicators as those in the experimental class. Students' critical thinking skills in the control class also improved, though not as significantly as in the experimental class.

This is further supported by the N-Gain test results, which showed a higher score of 0.600 (60%) in the experimental class, compared to 0.190 (19%) in the control class. This may occur because, during the pair stage, discussions are limited to just two people, resulting in a more limited exchange of ideas and perspectives among students. Furthermore, activities in TPS generally focus on the processes of thinking, discussing, and presenting findings; as a result, students' opportunities to conduct in-depth investigations, seek information from various sources, and analyze a problem comprehensively remain relatively limited. Therefore, it can be concluded that there was an improvement in both classes; however, it is evident that the experimental class, which used the Group Investigation (GI) model assisted by flashcards, demonstrated a greater improvement in critical thinking skills compared to the control class, which used the Think Pair Share (TPS) model.

CONCLUSION

Based on the results of the study presented above, it can be concluded that the implementation of the Group Investigation (GI) model aided by flashcards has a 60.1% impact on elementary school students' critical thinking skills in science, indicating that this model is effective in enhancing students' critical thinking skills.

Based on the results of the N-Gain test, the improvement in students' critical thinking skills in the class that used the Group Investigation (GI) model aided by flashcards was greater than that in the class that used the Think-Pair-Share (TPS) model. The experimental class achieved an N-Gain of 60% (fairly effective), while the control class achieved 19% (ineffective), indicating that the Group Investigation (GI) model supported by flashcards is more effective in improving elementary school students' critical thinking skills in science.

Theoretically, this study contributes to strengthening the social constructivist perspective by demonstrating that collaborative investigation and interaction among students can support the development of critical thinking skills. Practically, the findings imply that elementary school teachers can consider integrating the Group Investigation (GI) model with flashcards as an alternative approach to create more active, collaborative, and interactive science learning.

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