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The Effect of Using ChatGPT as a Learning Assistant on the Scientific Literacy of Fifth-Grade Elementary School Students: A Quasi-Experimental Study

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Abstract

The development of Generative Artificial Intelligence (GenAI), especially ChatGPT, opens up opportunities for the use of technology as a learning assistant to support the science learning process. This study aims to analyze the influence of the use of ChatGPT as a learning assistant on the science literacy of grade V elementary school students. The study used a quantitative approach with a quasi-experimental design and a pretest-posttest control group design pattern. The research subjects amounted to 42 students in class V of SD IT Luqman Al Hakim consisting of 18 students in the experimental class and 24 students in the control class. Data was collected using a science literacy test in the form of 10 description questions given before and after treatment. The data were analyzed using Analysis of Covariance (ANCOVA), with pretest scores as covariates and posttest scores as dependent variables. The results showed a significant difference in posttest scores between the experimental class and the control class after the initial ability was controlled, with values of F (1.39) = 5.131, p = 0.029, and η^2 = 0.106. The average posttest score was corrected in the experimental class of 51.41, while the control class was 39.15, with a difference of 12.26 points. These results show that the use of ChatGPT as a learning assistant has the potential to support the achievement of students' science literacy. However, the large contribution of treatment of 10.6% shows that the achievement of science literacy is also influenced by other factors outside of treatment.

Keywords ChatGPT; Elementary School; Learning Assistant; Quasi-Experimental; Science Literacy.

INTRODUCTION

Science literacy is one of the important competencies that need to be developed since basic education because it is related to students' ability to understand natural phenomena, use knowledge appropriately, and make decisions based on evidence. Science literacy is not only related to the ability to remember science concepts, but also includes the ability to explain phenomena scientifically, evaluate the investigation process, and interpret scientific data and

evidence (Haswan et al., 2025). The PISA framework places these skills as an important part of science literacy that allows students to use science knowledge to deal with real-life problems.

The urgency of strengthening science literacy is increasingly evident from the achievements of Indonesian students in international assessments. Based on the results of PISA 2022, only around 34% of Indonesian students have reached Level 2 or more in science, while the OECD average reaches 76%. At this level, students are at least able to recognize the right explanation of familiar scientific phenomena and use knowledge to determine the validity of a simple conclusion based on available data. This condition shows that the development of science literacy is still a challenge and needs to be started consistently from the elementary school level. (OECD, 2023); (Aiman et al., 2020)

At the elementary school level, science learning has a strategic position in building the foundation of science literacy because students begin to deal more systematically with various natural phenomena in the surrounding environment. However, science learning is not enough if it is only oriented to conveying concepts and achieving the correct answers. Students need to have the opportunity to ask questions, connect concepts to everyday phenomena, seek explanations, compare information, and use evidence to build conclusions. The latest study on science literacy learning in elementary schools also shows an increasing attention to technology-based and contextual learning approaches as an effort to strengthen students' science literacy. (Rosnanda et al., 2026); (Monica et al., 2021)

The development of Generative Artificial Intelligence (GenAI) then opens up new opportunities to support the science learning process. One of the widely used technologies is ChatGPT, which is an artificial intelligence-based model capable of responding to user questions interactively. In the context of education, ChatGPT has the potential to be used as a learning assistant that helps learners obtain alternative explanations, ask follow-up questions, explore a concept, and obtain feedback during the learning process. With these interactive characteristics, ChatGPT has the potential to provide more flexible learning support according to the needs of students (Gkintoni et al., 2025).

This potential is also beginning to be seen in the context of science learning. Research shows that ChatGPT can be integrated into various student literacy activities and has the potential to support strategies such as questioning, independent learning, more individualized learning support, and formative assessments. However, the study also shows concerns about the accuracy of information and the possibility of students' dependence on ChatGPT. Thus, the use of ChatGPT in learning should not be understood as a substitute for teachers or as a means to provide answers instantly. ChatGPT is more appropriately placed as a learning assistant that helps students' thinking processes when used in targeted learning designs. Students still need to be directed to ask questions, examine the information obtained, compare answers with other sources, and draw conclusions based on evidence. This approach is important because AI output is not always accurate and undirected use has the potential to drive dependency or simply copy answers. UNESCO also emphasizes that the use of GenAI in education needs to be carried out

in (Liando et al., 2026); (Sujana et al., 2025); (Abdillah et al., 2026) a human-centered, safe, ethical, age-appropriate manner, and considering pedagogical design and student protection.

This issue becomes even more important when ChatGPT is used at the elementary school level. Grade V students are at a developmental stage that allows them to begin to develop more systematic thinking skills, but still need assistance in sorting out information and building understanding based on concrete experiences. Therefore, the use of ChatGPT in this age group needs to be designed not to speed up the acquisition of answers, but to help students learn through questions, explanations, exploration, and information verification. With this position, ChatGPT has the potential to become a bridge between digital information sources and students' scientific thinking activities (Ajrina & Hidayah, 2026).

On the other hand, empirical evidence regarding the effectiveness of ChatGPT on the abilities of elementary school students, particularly science literacy, is still limited. Some of the initial research on ChatGPT in science learning focused more on user perception, the potential for technology integration, or its use by students and prospective teachers. Even research on the use of ChatGPT in science investigations shows that students can have difficulty asking effective questions and evaluating the quality of the answers given by AI if they do not get the right usage strategy. The findings suggest that the mere existence of ChatGPT does not automatically result in better learning; Its effectiveness depends largely on how the technology is placed in the learning process (Nur Hidayah & Aziz, 2025).

This gap shows the need for empirical research that directly tests whether the use of ChatGPT as a learning assistant can make a difference to the science literacy achievement of elementary school students. This kind of research is important because the use of AI in education is not enough to be assessed based on students' perceptions of technology, but needs to be seen from the change in abilities that are the goal of learning. In the context of science literacy, these changes can be seen through students' ability to understand and explain scientific phenomena, use knowledge to solve problems, and interpret information and evidence related to scientific phenomena.

Based on this description, this study was conducted to analyze the influence of the use of ChatGPT as a learning assistant on the science literacy of grade V elementary school students. ChatGPT is used as a companion in the learning process, while teachers continue to play the role of directors and controllers of the learning process. This research is expected to provide empirical evidence on the use of generative AI in science learning in elementary schools while providing a perspective that AI integration needs to be directed to strengthen students' scientific thinking processes, not replace them.

METHODS

This study uses a quantitative approach with a quasi-experimental design using a pretest–posttest control group design pattern. The study involved two groups, namely the experimental group that gained learning by utilizing ChatGPT and the control group that gained learning without the use of ChatGPT. Measurements were taken before and after treatment through the

administration of pretest and posttest. The pretest is given before the treatment to identify the initial ability of the student, while the posttest is given after the treatment to find out the achievement of learning outcomes after the learning process. The pretest score was then used as a covariate in the ANCOVA analysis to control for possible differences in initial ability between the experimental group and the control group.

Sampling in this study was carried out using the Saturated sampling technique. The sample in this study is 42 students in class V of SD IT Luqman Al Hakim with 24 students in class V for boys as a control class, and 18 students for class V for girls as an experimental class. Learning is carried out directly using a student center approach. The data collection technique used test instruments, namely pretest and posttest questions of 10 description questions each. Data were analyzed using Analysis of Covariance (ANCOVA) to determine the difference in posttest scores between the experimental group and the control group after controlling for the effect of pretest scores. In this analysis, the learning group was designated as an independent variable, the posttest score as a dependent variable, and the pretest score as a covariate.

Before ANCOVA, the analysis assumptions were first tested, including the variance homogeneity test using Levene's Test. The results of the Levene test showed that the variance of the two groups was homogeneous ($F = 1.361$; $p = 0.250 > 0.05$), so that the homogeneity assumption of variance is met. Furthermore, ANCOVA was used to test the research hypothesis with a significance level of 0.05. The difference is stated to be significant if the p value < 0.05. The amount of treatment contribution to the dependent variable is seen based on partial eta squared (η^2).

This research was carried out in August, starting in the experimental class, namely in class V Women. The initial stage is to give students an initial test (pretest) in the form of 10 description questions that aim to determine students' initial science literacy skills. After the pretest was carried out, it was continued by providing students with material on the respiratory system in humans, in the experimental class in class V Girls were given treatment of learning materials using the use of CHATGPT while in the control class, namely class V Boys learning material on the respiratory system in humans without the help of CHATGPT. Then give the postest 10 description questions in each experimental class and control class.

FINDINGS AND DISCUSSION

Findings

Covariance analysis (ANCOVA) was conducted to determine the difference in learning outcomes in the experimental class and the control class after being given treatment, with pretest scores used as covariates. Before the ANCOVA analysis was carried out, a variance homogeneity test was first carried out using the Levene's Test.

Table 1. The results of the Variance Homogeneity Test using Levene's Test.

Test for Equality of Variances (Levene's)			
F	df1	df2	p
1.361	1.000	40.00	.250

The results showed that the data variance in both groups was homogeneous, with values F = 1.361 and p = 0.250 (p > 0.05). Thus, the homogeneity of variance assumptions is fulfilled and the ANCOVA analysis can be continued.

Table 2. Results of the Variance Homogeneity Test using Levene's Test

ANCOVA - POSTES

Cases	Sum of Squares	df	Mean Square	F	p	η^2
KELAS	1311	1	1310.9	5.131	.029	0.106
PRETES	1115	1	1114.7	4.363	.043	0.090
Residuals	9964	39	255.5			

Note. Type III Sum of Squares

The results of ANCOVA showed that there was a significant difference in the post-test score between the experimental class and the control class after controlling the pretest score, with values of F(1.39) = 5.131, p = 0.029, and η^2 = 0.106. A η^2 value of 0.106 showed that the treatment contributed to the variation in the postes score by 10.6%, while the rest was influenced by other factors outside the study model.

In addition, the pretest score also showed a significant influence on the postes score, with the values of F(1.39) = 4.363 and p = 0.043. These findings show that students' initial abilities need to be considered in interpreting the results of the postes. Therefore, the use of ANCOVA in this study allows the comparison of the results of the two groups to be carried out more precisely by controlling for differences in students' initial abilities. Based on estimated marginal means, the average post-test score adjusted based on the pretest score in the experimental class was 51.41 (SE = 3.956; 95% CI [43.41–59.41]), while in the control class it was 39.15 (SE = 3.386; 95% CI [32.30–46.00]). Thus, the experimental class had an average corrected postes score of 12.26 points higher than the control class. The difference is also statistically significant, t(39) = 2.265, p = 0.029.

Discussion

The results showed that there was a significant difference in learning outcomes between the experimental class and the control class after the pretest score was controlled. The value of F(1.39) = 5.131 with p = 0.029 indicates that the differences between the two groups did not occur by chance. The experimental class obtained an estimated marginal mean of 51.41, while the control class was 39.15, so there was a difference of 12.26 points. These findings show that students who received treatment in the experimental class showed better learning outcomes than students in the control class.

This research is in line with research from (Nawangsih et al., 2025) those who stated that the use of ChatGPT can increase effectiveness in the learning process, especially in terms of understanding material and completing tasks. Thus, ChatGPT has the potential to be an effective tool in supporting education at the elementary level, especially for Madrasah Ibtidaiyah students. The results of the analysis showed that the pretest score also had a significant effect on the postes score ($F(1.39) = 4.363$; $p = 0.043$). This shows that the initial ability of students is one of the factors related to the achievement of final learning outcomes. By controlling for these variables, the difference in post scores between the experimental and control classes can be interpreted more objectively as a difference after considering the initial condition of the students.

Substantively, the higher corrected post score in the experimental class showed that the use of ChatGPT in learning gave better results than learning in the control class. ChatGPT can provide interactive learning support, especially in helping students get explanations, develop understanding of the material, and get feedback during the learning process. These interactions allow students to not only receive information, but also explore the material based on their learning needs. This is in line with research that states that AI as a virtual laboratory assistant is able to provide experimental guidance, analyze data automatically, and provide direct feedback to students. In addition, the integration of AI in virtual labs and virtual reality has been proven to improve students' understanding of concepts, science process skills, and learning motivation. However, the application of this technology still faces challenges such as limited infrastructure, digital literacy, and educator readiness. Therefore, the development and implementation of AI in virtual laboratories needs to be continuously improved to support more effective, interactive, and inclusive science learning. (Wahyudi et al., 2026)

The magnitude of the effect obtained needs to be interpreted proportionally. A value of $\eta^2 = 0.106$ indicates that the treatment explains about 10.6% of the variation in postes scores after taking into account the covariates. This means that the use of ChatGPT has a significant contribution to learning outcomes, but it is not the only factor that determines student achievement. Other factors such as early ability, learning engagement, motivation, learning strategies, intensity of technology use, and individual characteristics of students may also contribute to learning outcomes. These findings also show that the effectiveness of ChatGPT in learning needs to be understood not solely as the use of technology, but as part of a targeted learning strategy. The use of ChatGPT will be more meaningful if students are still directed to think critically, through an investigation-based learning model with the support of ChatGPT showing positive steps in improving the digital literacy of elementary school students, providing a foundation to navigate the demands of digital literacy in the ever-evolving information age. Thus, ChatGPT should be positioned as a learning tool that supports students' cognitive activities, not as a substitute for students' thinking processes. Thus, the results of the study provide an indication that the integration of ChatGPT in learning can be an alternative to improve student learning outcomes. However, its implementation still requires a structured learning design so that the use of technology not only increases access to

information, but also encourages students' understanding, engagement, and thinking skills. (Furqon Al Hadiq et al., 2023).

CONCLUSION

Based on the results of the research, it can be concluded that the use of ChatGPT as a learning assistant makes a significant difference to the science literacy of grade V elementary school students. The results of ANCOVA's analysis showed that there was a difference in posttest scores between the experimental class and the control class after the students' initial ability was controlled, with the values of $F(1.39) = 5.131$, $p = 0.029$, and $\eta^2 = 0.106$. The experimental class obtained an estimated marginal mean of 51.41, while the control class was 39.15, with a difference of 12.26 points.

The findings show that the use of ChatGPT as a learning assistant has the potential to support students' science literacy achievements. However, a η^2 value of 0.106 indicates that the treatment explains about 10.6% variation in science literacy scores, so that students' improvement in ability is not only influenced by the use of ChatGPT, but also by other factors in the learning process. Therefore, ChatGPT should be placed as a companion to the learning process, not as a substitute for teachers or as a substitute for students' thinking processes. Its use needs to be accompanied by the teacher's direction so that students continue to carry out the process of understanding, questioning, evaluating, and verifying information obtained from AI.

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