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The Influence of an Integrated STEM Project-Based Learning toward Science Literacy Abilities Students in Elementary School

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Abstract: The purpose of this research is to prove the influence of an integrated STEM project-based learning toward science literacy abilities students, given the low science literacy skills among elementary school students. A quasi-experimental quantitative approach was used to collect data on literacy abilities, using a test questionnaire as an instrument for data collection. The data was analyzed using independent sample t-tests and paired sample t-tests. The results of the independent sample t-test showed a significance value of 0.03 < 0.05, which means that the null hypothesis (H_0) was rejected and the alternative hypothesis (H_a) was accepted. This indicates that students' science literacy abilities were better when they learned using the integrated STEM project-based learning model compared to the conventional model. Furthermore, the results of the paired sample t-test showed a significance value of 0.00 < 0.05, which means that Ha was accepted and H_0 was rejected, indicating that the implementation of the integrated STEM project-based learning model can improve students' science literacy abilities. Based on these findings, it can be concluded that the implementation of the integrated STEM project-based learning model is effective in improving students' science literacy abilities.

Keywords: Elementary school; Integrated STEM project-based; Science literacy abilities

Introduction

Education is an effort that can be undertaken to prepare students to actively develop their potential, abilities, and talents through learning activities (Mishra et al., 2020). Education plays a crucial role in human life as it enhances the quality of life and enables individuals to develop their existing potential (Bin Amiruddin et al., 2022). Students can expand their educational abilities with technology and can improve the quality of their future careers and social life (González-pérez et al., 2022). Science or STEM education is one of the branches of knowledge that holds significant importance in human life. Science education aims to shape individuals who are scientifically literate and technologically aware, thus enabling them to become high-quality human resources capable of facing the challenges of industrialization and globalization (Yuliati et al., 2020). Science has a profound impact on personal lives, society, and the global economy, making it vital for the development of human resources (Bahri et al., 2021). To succeed in this century, students must possess good scientific literacy skills. Strong reading skills enable students to develop a habit of reading for learning purposes and enhance their ability to comprehend subject matter (Oktarina et al., 2023).

Science literacy is the ability of students to understand, communicate, and apply scientific skills in solving real-life problems (Nuraini et al., 2023). Science literacy is essential for individuals to improve themselves and adapt to life, particularly in terms of reading proficiency, which enables them to adapt and contribute to the development of a nation (Adnan et al., 2021). Science literacy involves scientific thinking and critical thinking, as well as using scientific knowledge to develop and make informed decisions (Suwono et al.,

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2019). Science literacy encompasses concepts and processes of science that allow individuals to draw conclusions and participate in matters of governance, economic growth, and culture (Rini et al., 2021). To compete in the modern era and equip students with the skills to navigate changing times, science literacy is crucial to be taught at the elementary school level. Science literacy is an important component for every student to master as it relates closely to how individuals understand the environment and the challenges faced by a technology- and science-driven society. Science literacy involves knowledge to recognize concepts, understand, explain, identify, communicate, and apply scientific knowledge (Ma'sumah et al., 2021). In conclusion, the mastery of science literacy is crucial due to the rapid development of technology and science. Therefore, the ability to think systematically, creatively, critically, and communicate across various fields is essential for every individual (Oktarina et al., 2023).

Data and research indicate that more than 10 million students in OECD countries have low levels of literacy. Compared to 2009, there has been no significant improvement in science literacy skills (≤ 2%). Indonesia is one of the countries with low levels of science literacy (Summaries, 2010). According to the Trends in International Mathematics and Science Study (TIMSS) 2015 assessment, Indonesian fourth-grade students scored 397 points, ranking 44 out of 49 countries (McComas, 2014). The reading interest of the Indonesian population is concerning, with only 0.001% of 1,000 individuals showing interest in reading according to UNESCO (Prasrihamni et al., 2022). The Indonesian government has made efforts to improve students' literacy skills, including reading literacy, science literacy, and mathematics literacy. The implementation of a curriculum that emphasizes integrated learning is part of the government's policies. However, the level of science literacy among students in Indonesia is still below average. This is influenced by various issues, including the education system, curriculum, teaching methods and models chosen by teachers, learning facilities, learning resources, and teaching materials. The low level of science literacy experienced by students is due to the suboptimal mastery of the learning process, lack of students' seriousness in learning, inadequate learning facilities both inside and outside the classroom, and disorganized science learning processes, resulting in low science literacy among students (Dharin et al., 2023).

The issue of literacy skills has long been a focus of discussion and debate in various media. Students' literacy skills play a crucial role in shaping their learning behavior (Saidaturrahmi et al., 2021). Reasoning, logic, critical analysis, and creativity are components that shape science literacy skills. To develop these components, indicators of science literacy are necessary. PISA 2018 divides science literacy indicators into three aspects: (1) Explaining phenomena scientifically, (2) Evaluating and designing scientific investigations, (3) Interpreting data and evidence scientifically (PISA, 2019). PISA 2018 also divides the assessment of students' science literacy into three parts: (1) Context, which refers to situations that present problems and provide information for finding solutions, (2) Knowledge, which involves understanding facts, concepts, and explanatory theories as the foundation of knowledge, (3) Competencies, which are the abilities to explain phenomena scientifically, evaluate, design, and interpret data and evidence scientifically (PISA, 2019).

The reality is that many students in elementary schools still have low science literacy skills. This is evident from the results of a pre-research test conducted by researchers on January 9, 2023, at Boro Elementary School, focusing on the topic of temperature and heat. The test results from Boro Elementary School's 5th-grade class indicate that students' science literacy skills are still relatively low, as seen from an average test score of 45.2, which signifies a very low level of science literacy among the students at Boro Elementary School. The insufficient science literacy skills among students are also attributed to a learning process that does not yet focus on science literacy (Permana et al., 2020). The lack of active engagement by students during learning activities also contributes to the low science literacy skills. Students have not been actively developing their reasoning abilities during the ongoing learning process (Nuraini et al., 2023). This is supported by the results of interviews conducted at Boro Elementary School, where many students are still not competent in explaining natural phenomena scientifically. They are also unable to restate acquired knowledge in their own words. Additionally, students still struggle with problem-solving related to science. The results of these interviews indicate that the teaching practices being used have not yet been directed towards science literacy.

Efforts to address the issues at Boro Elementary School involve innovation and changes in the learning process to expand the creativity, mindset, and science literacy of the students. One strategy that can be used to enhance creativity, mindset, and science literacy is Project-Based Learning. Project-Based Learning is a teaching model where the core of the learning process revolves around project activities (Giwanti et al., 2021). The Project-Based Learning model is employed to help students easily grasp the subject matter by engaging in hands-on activities. This enables students to analyze, respond to, and solve problems they encounter (Lianti et al., 2023). The implementation of Project-Based Learning offers several benefits, including: (a). Direct student engagement in real-life interconnected problems, aiming to describe issues and challenges in daily life; (b). The utilization of inquiry techniques, research, planning skills, critical thinking, and problem-solving skills during project creation; (c). Continuous student involvement in project development to apply their knowledge and skills in various contexts; (d). Opportunities for students to learn and enhance interpersonal skills while working collaboratively in groups with adults; (e). Providing time for students to utilize the necessary skills and competencies for life and work; (f). Encouraging critical thinking through speculative actions that relate to experiences and connect them to learning standards (Raehanah et al., 2020). Project-Based Learning can also be integrated with the STEM (Science, Technology, Engineering, and Mathematics) approach. Research has shown that the implementation of STEM-based Project-Based Learning can improve science literacy, make learning more meaningful, and help students solve real-life problems (Giwanti et al., 2021). Through Project-Based Learning, students can identify the problems they face, search for solutions from various sources, and use their abilities and knowledge to solve the problems at hand (Yamin et al., 2020).

Project Based Learning learning model focuses on generating scientific products that can enhance students' science literacy (Ansumarwaty et al., 2023). Project-based learning is a type of learning that organizes students to construct knowledge independently through investigation and discussion to solve a problem and achieve planned targets (Farcis et al., 2022). Developing project-based teaching materials integrated with STEM in science subjects is one solution to improve science literacy skills (Izzania, 2021). Project-Based Learning integrated with STEM is an effort to enhance creativity for students and improve the quality of learning activities. With the integrated model, the learning process becomes more meaningful, and students can be more active and solve problems themselves. Project-Based Learning integrated with STEM can enhance students' science literacy, problem-solving skills, and communication skills through the use of digital media technology (Afriana, 2022). The role of technology cannot be denied as a tool to facilitate human activities, including learning. Digital media can be used as a learning resource when the surrounding environment, tools, or materials are not feasible or may even pose risks. The use of the STEM approach in learning provides variation and innovation, allowing students to learn by connecting real-life problems.

The STEM (Science, Technology, Engineering, and Mathematics) learning approach is an approach that combines four disciplines that were initially separated in traditional learning activities and applies them to make learning relevant for students. The four integrated disciplines in the STEM approach are Science, Technology, Engineering, and Mathematics, and each discipline is no longer taught separately but treated as a dynamic and cohesive unit (Hardiman et al., 2019). The STEM approach guides students to develop a comprehensive understanding, become more adept at addressing everyday problems, and foster critical thinking skills (Afriana, 2022). By implementing Project-Based Learning with an integrated STEM approach, students can be facilitated in developing their science literacy skills in dealing with contextual problems (Chen et al., 2019). Project-Based Learning with the STEM approach can stimulate students' curiosity and enhance their science literacy (Waluyo et al., 2021).

The steps or syntax of Project-Based Learning developed by The George Lucas Educational Foundation are as follows: (1) Starting with Essential Questions - selecting a topic that is relevant to the real world. This is aimed at eliciting knowledge, responses, criticisms, and ideas from students on the project theme to be undertaken, (2) Planning Project Work Rules - planning project work rules, selecting activities that support answering essential questions, integrating various subjects, and determining the tools and materials needed for project completion, (3) Scheduling Activities - collaboratively scheduling project completion activities between teachers and students. This is done to determine the time needed to complete the project, (4) Monitoring - teachers monitor project work carried out by students, facilitating students at every stage of the project, (5) Evaluation - assessment is done to measure the achievement of standards, evaluate student progress, and provide feedback on the level of understanding achieved by students. Students present the results of their project work and write a report on the work done, (6) Reflection - teachers and students reflect on the activities and results of the project undertaken. At this stage, students are asked to express their feelings and experiences during the project completion process.

Based on the description provided above, it is indeed necessary to conduct research on how the Project-Based Learning model integrated with STEM can influence students' science literacy skills. The chosen topic of Environmental Conservation is closely related to current actual phenomena, which can help students develop their science literacy abilities. Students are expected to observe and understand the phenomena that occur in their surrounding environment when learning about environmental pollution. Therefore, this research needs to be conducted to determine the impact of the Project-Based Learning model integrated with STEM on students' science literacy skills at Boro Elementary School.

Method

This study utilizes a quantitative approach, which involves the use of numerical data. It specifically employs a quasi-experimental or quasi-experiment design. Quasi-experimental design is an extension of the true experimental design, which is challenging to implement. Quasi-experiments include a control group but may not fully control external variables that influence the experiment (Sugiyono, 2013). Experimental research design is a type of research design that aims to investigate the cause-and-effect relationship of specific characteristics between groups that receive treatment and those that do not. Experimental research also involves the deliberate manipulation of variables or relationships between variables (Zyphur et al., 2020). Quasi-experimental research can provide information that predicts findings obtained through actual experiments under conditions where it is not possible to control all relevant variables.

Table 1. Non-equivalent Control Group Design

Group	Pretest	Independent Variable	Posttest
Experiment	O_1	X_1	O_3
Control	O_2	X_2	O_4

Explanation of Table 1:
X_1: Giving the Project-Based Learning model integrated with STEM.
X_2: Giving conventional learning model.
O_1: Pretest results of the experimental group.
O_2: Pretest results of the control group.
O_1: Posttest results of the experimental group.
O_2: Posttest results of the control group.

The study utilizes a nonequivalent control group design, which is similar to the pretest-posttest control group design, but in the nonequivalent design, the experimental and control groups are not selected randomly. This design involves two groups: the experimental group (which receives the Project-Based Learning integrated with STEM models) and the control group (which receives conventional teaching methods). Both groups will undergo a pretest before the intervention and a posttest after the intervention. The independent variable is represented by the implementation of the treatment, where the experimental group receives the intervention using the Project-Based Learning integrated with STEM model, while the control group receives the conventional teaching method. The dependent variable is the science literacy ability.

The use of pretests and posttests is employed to assess the level of success in implementing the instructional model through pretest and posttest measures. The pretest provides an overview prior to the implementation of the instructional model, aiming to understand the initial state of the students' science literacy skills. It helps to determine the baseline level of science literacy abilities among the students. On the other hand, the posttest provides an overview after the implementation of the instructional model to evaluate the extent of the impact of the Project-Based Learning integrated with STEM model. If a significant change in the students' science literacy abilities is observed during the science learning process in the experimental group, it can be concluded that the results of the experiment are influential. The presence of significant changes in the students' science literacy abilities during the implementation of the Project-Based Learning integrated with STEM model indicates the impact of the experiment.

When conducting research, population and sample are crucial elements. The population refers to a large group within an institution or organization that will be studied. In this study, the population consists of students from SD Negeri Boro in Tanggulangin sub-district, Sidoarjo city. The sample, on the other hand, represents a group of individuals or items. The sample used in this study includes students from class VA as the experimental group and class VB as the control group. The sampling technique employed is probability random sampling, where 16 students are randomly selected from each class, resulting in a total sample size of 32 students. The research instrument used in this study is an assessment test sheet designed to measure the students' science literacy abilities. The test sheet is divided into two parts: the pretest and the posttest. The pretest is conducted at the beginning of the learning process to assess the level of science literacy abilities before implementing the Project-Based Learning integrated with STEM model, while the posttest is administered to evaluate the science literacy abilities after implementing the Project-Based Learning integrated with STEM model. The pretest and posttest questionnaires have undergone validity and reliability tests, resulting in 10 valid and reliable questions. The scoring technique involves assigning a score of 10 for correct answers and a score of 0 for incorrect answers. Data collection is the method used by the researcher to obtain data from the conducted research, which includes the test sheets. The data obtained from this study is the students' science literacy abilities. The data collection instrument used in this study is the pretest and posttest questionnaires.

Before conducting data analysis, preliminary tests such as normality and homogeneity are performed using the SPSS version 26.0 for Windows software (Alita et al., 2021). The data analysis technique utilized in this study is inferential data analysis, specifically the independent sample t-test and the paired sample t-test. The analysis is performed using the SPSS version 26.0 for Windows software.

Result and Discussion

Project Based Learning integrated STEM is a learning model that requires students to create a project (Ansumarwaty et al., 2023). By utilizing the Project-Based Learning integrated with STEM model, students' curiosity and scientific literacy can be nurtured. This instructional approach fosters an environment where students are motivated to explore and develop their sense of inquiry (Afriana, 2022). The VA class, as an experimental class, implemented an integrated STEM project-based learning model to create a simple project, which was a water purifier. This activity was conducted twice. On the first day, students were introduced to the project-based learning model's framework. In the initial phase, students were presented with a topic relevant to everyday life, which was the issue of water. The teacher presented a problem to the students, and they were asked to analyze two provided images, focusing on the transformation from a polluted river to a clean one. The teacher guided them in thinking about this transformation. The following quote illustrates this process:

Teacher: "Which picture is better to look at?"
Amel: "Picture B."
Teacher: "What is your reason for choosing picture B?"
Satrio: "Because the river in picture B looks clean."
Aisyah: "There is no trash."
Teacher: "Correct. The river in picture A is not pleasant to look at because of the accumulation of garbage. Based on this picture, what should you do to make the water in the river clear?"
Students: "Clean the river from the trash, and do not throw trash in the river."

During this learning process, we can observe that the teacher encouraged the students to predict and explain which images were suitable to examine and what needed to be done to make the river clean.

Figure 1. Designing product planning

The results in Figure 1 the second phase involved the teacher guiding the students in creating a project planning design for a water filtration device. The students sought information from electronic media regarding various water filtration device designs. After finding these designs, the students were asked to list the materials and steps on a provided worksheet. Following this, the students designed the water filtration device and created a sketch of the device's design. When designing the water filtration device, the students created design plans with various material arrangements. Moving on to the third phase, the students were asked to create a schedule for completing the product. They discussed the product completion schedule with their groupmates, aiming to determine how long it would take to finish the product.

On the second day of learning, which began with the fourth phase, the teacher monitored the progress of the water purification design project. The teacher inquired about the project's development, starting with which materials had been gathered to conduct a test with the simple water purification device. Following this, the teacher guided the students to start the experimentation process. The students began by preparing the tools and materials to be used in assembling the simple water purification device in accordance with the sketch created on the first day. Once the arrangement of materials for the water purification device was completed, the students then proceeded to conduct a test by pouring murky water into the assembled simple water purification device.

Figure 2. Product trials

The results in Figure 2 In the first experiment, using a combination of materials including sponges, palm fibers (ijuk), charcoal, and coconut fibers, the students obtained somewhat murky water during the first filtration attempt. They continued filtering the water repeatedly, and by the 8th filtration, the water had become clear. In the second experiment, with a different material combination of cotton, tissue, pebbles, coconut fibers, charcoal, and tissue, the initial filtration produced clear water. For this experiment, they only conducted one filtration. After all the groups completed their experiments, they drew conclusions from the tested products. In the fifth phase, the assessment of the students' work involved summarizing the results of the water purification device experiments. They found that the devices made by each group with different material combinations resulted in different water quality. In the first experiment, the water was initially somewhat unclear, but repeated filtrations (up to 8 times) improved its clarity. This was due to the use of sponges, which did not effectively absorb impurities from the murky water, and the materials were not densely packed, hence the need for repeated filtration. In contrast, in the second experiment, a single filtration yielded clear water because the cotton and tissue in the device could immediately absorb impurities from the murky water. In the sixth phase, both the teacher and the students were asked to evaluate and reflect on the activities and the outcomes of the water purification project. At this stage, the students were encouraged to express their feelings and experiences during the process of completing the simple water purification project.

The activity was conducted in two classes, namely VA and VB. Class VA was designated as the experimental group, which received the integrated STEM-based Project-Based Learning model, while class VB received conventional teaching methods. The subject matter covered in the study was Theme 8, Sub-theme 3: Environmental Conservation Efforts. The discussion of the research results will present data on the learning outcomes of both the experimental and control groups. The experimental group received the Project-Based Learning-STEM integrated teaching model, while the control group received conventional teaching methods. After implementing the Project-Based Learning-STEM model in the experimental class and conventional teaching methods in the control class, pre-test and post-test scores were obtained for both groups to assess their learning outcomes.

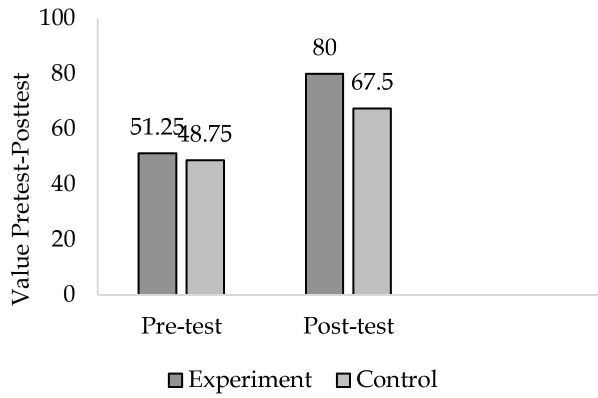

Figure 3. The pretest and posttest results

The results in Figure 3 indicate that the science literacy scores in the experimental class before implementing the integrated STEM-based Project-Based Learning model were 51.25, and after implementing the model, the scores increased to 80. This improvement can be attributed to the fact that in the Project-Based Learning-STEM integrated teaching approach, students play a significant role in formulating and solving problems during the learning process. Furthermore, the impact of using the Project-Based Learning-STEM model for problem-solving was assessed through hypothesis testing, which serves as a prerequisite for the evaluation. The summary of the hypothesis testing is presented in Table 2.

Table 2. Test of Homogenity

Levene Statistic	df1	df2	Sig.
0.808	1	30	0.376

Based on the data in Table 2, the Homogeneity Test was conducted using SPSS for Windows version 26, using the Levene's test. The result showed a significance value based on mean of 0.376. According to the decision rule, if the significance value of the mean is found to be > 0.05, the data can be concluded as homogenous. After that, the sample was determined using simple random sampling method. Simple random sampling was carried out by randomly selecting 16 students from class VA as the experimental group and 16 students from class VB as the control group. Subsequently, the normality test was conducted, as presented in Table 3.

Table 3. Tests of Normality

Tests of Normality				
	Class	Shapiro-Wilk		
		Statistic	df	Sig.
Student Learning Outcomes	Pretest Experiment	0.922	16	0.184
	Posttest Experiment	0.911	16	0.122
	Pretest Control	0.922	16	0.182
	Posttest Control	0.921	16	0.176

Based on the results in Table 3, the normality test was conducted using SPSS for Windows version 26. Using the Shapiro-Wilk formula, the significance value for both pretest and posttest in the experimental and control groups was > 0.05. This indicates that the pretest and posttest data in both the experimental and control groups are normally distributed. Since the normality test results are normally distributed, the data analysis can proceed.

Pretest data analysis, conducted before implementing a STEM-based Project-Based Learning model, aims to determine whether there is a difference in the average initial science literacy skills of students between the experimental and control classes. If the significance value is less than 0.05, then H_0 (the null hypothesis) is rejected, and H_a (the alternative hypothesis) is accepted, indicating a significant difference. Subsequently, a hypothesis test is performed to understand the true situation in the experimental and control classes using a t-test to determine whether there is a difference in science literacy skills, as presented in the table below.

Table 4. Hypothesis Test Independent Sample T-Test Pretest

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Learning Outcomes Pretest	Equal variances assumed	0.808	0.376	0.587	30	0.561	2.500	4.257	-6.195	11.195
	Equal variances not assumed			0.587	29.019	0.562	2.500	4.257	-6.207	11.207

Based on Table 4, the t-test on the pretest data yielded a significance value of 0.561, which means that the significance value > 0.05. This indicates that there is no significant difference or it can be said that the science literacy skills of the fifth-grade students at SD Negeri Boro in both the experimental and control groups are the same.

Next, a hypothesis test was conducted to determine the science literacy skills of the students in the experimental and control groups using the Independent Sample t-test. The hypothesis testing was assisted by the SPSS 26.0 application for windows with a significance level of α = 0.05 or 5%. If the significance value is < 0.05, then H0 is rejected and Ha is accepted, indicating that the science literacy skills of the students in the experimental group are better than those in the control group, and vice versa. The hypothesis test through t-test is presented in the following table.

Table 5. Hypothesis Test Independent Sample T-Test Posttest

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Learning Outcomes Posttest	Equal variances assumed	1.596	0.216	3.273	30	0.003	12.500	3.819	4.701	20.299
	Equal variances not assumed			3.273	28.846	0.003	12.500	3.819	4.688	20.312

Based on Table 5, the t-test on the posttest results of the students yielded a significance value of 0.03, which means that the significance value < 0.05. This indicates that the science literacy skills of the students who received the project-based learning model integrated with STEM are better compared to the conventional model. Therefore, it can be concluded that the use of project-based learning model integrated with STEM has an effect on the science literacy skills of the students in class VA at SD Negeri Boro.

The next hypothesis test is to determine whether there is an improvement in the scores after the implementation of the project-based learning model integrated with STEM in the experimental group. This test uses the paired sample t-test.

Based on Table 6, the significance value obtained was 0.00, which is less than 0.05. This indicates that there is a significant influence of students' science literacy ability after the implementation of the Project-Based Learning integrated STEM model at SD Negeri Boro. Therefore, it can be concluded that the implementation of the Project-Based Learning integrated STEM model has a significant effect on students' science literacy ability. The difference in models and methods used in the learning process between the experimental and control groups can differentiate the results of students' science literacy ability. The implementation of the Project-Based Learning integrated STEM model makes students more active. By using the Project-Based Learning integrated STEM model, learning becomes more interesting and engaging (Afriana, 2022). Thus, the implementation of the Project-Based Learning integrated STEM model in learning is expected to provide a new experience for students, thereby motivating and stimulating their interest in learning environmental conservation topics. Through project-based learning, students can develop their creativity and make learning more meaningful. This can make students remember the knowledge they have gained during the process of using the Project-Based Learning integrated STEM model for a longer period. The integration of STEM (Science, Technology, Engineering, and Mathematics) makes it possible for students to apply both knowledge and skills simultaneously to solve problems encountered.

Table 6. Hypothesis Test Paired Sample T-Test

		Paired Samples Test							
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Posttest	-28.750	15.000	3.750	-36.743	-20.757	-7.667	15	0.000

The results of the project in learning consist of a water purification tool and accompanying teaching materials (LKPD). The implementation of the subject matter concept through STEM-integrated Project-Based Learning can train students to understand concepts comprehensively through contextual application, enabling them to conduct investigations into the learning material and discover processes to solve problems. This aligns with what (Afriana, 2022) has mentioned, that the STEM approach can guide students to attain a thorough understanding, become more adept at addressing everyday life issues, and enhance their scientific literacy skills. The project task is carried out in groups, involving the experimentation with a water purification tool. The water purification tool is designed using various materials. Students will attempt to connect the concepts they have learned with the problem they aim to solve in the project. The students' problem-solving abilities can be observed through their description of the problem and the solutions they propose (Chen et al., 2019).

Based on the research results obtained by the researcher, they align with the findings of previous studies conducted by Giwanti et al. (2021), Afriana (2022), and Waluyo et al. (2021) regarding the science literacy achievements of students. These studies indicate that students in the experimental group, who used STEM-based Project-Based Learning, achieved higher average scores compared to students in the control group using conventional teaching methods. Giwanti et al. (2019) found that science literacy scores were higher on average for students in the experimental group using STEM-based Project-Based Learning compared to those in the control group using conventional teaching methods. Similarly, Afriana (2022) reported that the experimental group achieved higher average scores than the control group when using the project-based learning-STEM model in both groups, with the control group receiving conventional instruction. Waluyo et al. (2021) also supported the idea that the implementation of Project-Based Learning can improve student learning outcomes and science literacy. Through Project-Based Learning with integrated science literacy, students can identify the problems they face and seek solutions from various sources.

These studies collectively suggest that STEM-based Project-Based Learning can be an effective approach to enhance science literacy and academic achievement among students, as it encourages active engagement, problem-solving skills, and a deeper understanding of scientific concepts.

Conclusion

Based on the results of the research, the Project Based Learning model integrated with STEM has an effect on the science literacy skills of fifth-grade students at SD Negeri Boro. This is evidenced by the hypothesis test results using independent sample t-test, where the significance value is 0.03, which means < 0.05, so H_a is accepted and H_0 is rejected. This indicates that the science literacy skills of the students in the class that used the Project Based Learning model integrated with STEM are better compared to those who used the conventional model. Furthermore, based on the results of the paired sample t-test, the significance value is 0.00, which means < 0.05, so H_a is accepted and H_0 is rejected. This indicates that there is an effect on the science literacy skills after the implementation of the Project Based Learning model integrated with STEM. Therefore, it can be concluded that the implementation of the Project Based Learning model integrated with STEM has an effect on the science literacy skills of elementary school students at SD Negeri Boro. The author suggests that for future research on science literacy skills of students, the researchers should use test instruments that pay attention to the same number and level of questions in each aspect of science literacy and the tested content material. The researchers are also expected to use more diverse sources to improve the quality of the research.

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The authors declare no conflict of interest.

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