

Research Article

## The Effect of the Project-Based Learning Model in Terms of Learning Styles on the Literacy and Numeracy Skills of Elementary School Students

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**Abstract:** This study aims to determine the effect of the project-based learning model in terms of learning styles on the literacy and numeracy skills of fourth-grade elementary school students in the Jamblang sub-district in 1 cluster, namely SDN 1 Wangunharja, SDN 2 Wangunharja, SDN 1 Sitiwinangun, SDN 2 Sitiwinangun, SDN 3 Sitiwinangun, SDN 1 Bojong Wetan, SDN 2 Bojong Wetan, and SDN 3 Bojong Wetan. This study used a quantitative method with a one-group pretest-posttest design. The sample in this study consisted of all 240 fourth-grade elementary school students. The research instruments consisted of a learning style questionnaire, literacy and numeracy tests with multiple choice questions for the pretest and posttest. Data collection was conducted before and after the implementation of the PjBL learning model. Data analysis included validity, reliability, normality, homogeneity, simple linear regression analysis, and paired sample t-test. The results show that each data point in the variables also meets the assumptions of normality and homogeneity. From the descriptive statistics calculation results, the hypothesis test of simple linear regression analysis and the paired sample t-test show a significant difference between the pretest and posttest scores for students' literacy and numeracy abilities. with the students' literacy ability level at the time of the pretest averaging 42.88 and the posttest score averaging 76.33, and the students' numeracy ability level at the time of the pretest averaging 43.46 and the posttest score averaging 71.21. Based on the hypothesis test, the significance value of each variable was 0.000 (<0.05), so  $H_0$  was rejected and  $H_a$  was accepted. This shows that the learning model was able to significantly improve students' literacy and numeracy skills. This study contributes novel empirical evidence by integrating Project-Based Learning assisted by e-modules with students' learning styles in examining literacy and numeracy outcomes simultaneously at the elementary school level, an aspect that remains limited in prior quantitative pre-experimental studies.

**Keywords:** elementary school, learning styles, literacy, numeracy, project-based learning

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## **INTRODUCTION**

Education is the right means to improve and develop the quality of human resources (HR). To create superior and competitive human resources, education must be designed in a way that enables the next generation to have the necessary skills. One way to do this is by improving the quality of education (Haniyya, 2016). The Indonesian government is striving to improve education, one of which is by improving reading and writing skills, as they recognize the importance of education. Reading and writing are not just about reading letters and characters, but also reading the universe and reading in mathematical numbers, often referred to as numeracy (Majid, 2019). The skills that students must have in education are literacy skills, namely the ability to understand, interpret, and use written or printed information in various forms, such as text, images, and tables. Literacy skills also include the ability to access, evaluate, and use information from various sources, such as books, articles, and the internet.

The word literacy comes from the Latin word *littera* (letter), which means mastery of writing systems and accompanying conventions (Mutia'ah, Irmayanti, et al., 2020). The United Nations Educational, Scientific and Cultural Organization (UNESCO) explains that literacy is a set of practical skills, that literacy is everyone's right, and that it is the foundation for lifelong learning. Literacy is defined as the ability to read, write, and do numeracy (Eka, 2020). According to Piqriyatun & Kurnia (2024), literacy is a skill that includes the ability to read, write, and understand meaning and text, which is related to an individual's cognitive abilities. Literacy skills are not limited to reading and writing, but also include numeracy, including mathematical literacy. This aspect is very important in solving problems and making decisions in everyday life. PISA specifically defines mathematical literacy as an individual's ability to think mathematically, as well as to construct, use, and understand the meaning of mathematical concepts in order to solve problems in various real-life contexts (Yunarti, 2022).

In Indonesia, student capacity is currently measured in terms of reasoning skills using mathematics (numeracy), as well as reasoning skills using language skills (literacy) and character education reinforcement (Ministry of Education and Culture, 2021). PISA (Programme for International Student Assessment) is a study conducted by the Organization for Economic Co-Operation and Development (OECD). PISA is one of the alternatives used by countries to improve the quality of learning, particularly in literacy, mathematics, and science. Based on a survey conducted by the Program for International Student Assessment (PISA) in the Organization for Economic Co-Operation and Development (OECD) in 2018. In the 2018 PISA results, Indonesia ranked in the bottom 10 out of 79 participating countries. The average score for Indonesian students was 80 points below the OECD average. The literacy skills of Indonesian students are still below those of students in other countries (Nur Rafika, 2023).

PISA data for 2022 shows that Indonesia's mathematics numeracy score dropped by 13 points, from 378 to 366 (OECD, 2023). This data indicates that numeracy literacy remains low (Hutauruk & Ardiansyah, 2024). Based on the results of observations conducted by researchers at SDN 1 Wangunharja, Jamblang District, during social studies lessons, when teachers used learning evaluation strategies to assess students' work on student worksheets (LKPD), there were story questions that required theoretical problem solving. When the teacher gave the questions to the students, some students still had difficulty understanding the questions, so they still needed guidance from the teacher. There were also students who were not careful enough in reading the questions, so in the process of solving the questions,

there were mistakes such as errors in writing, lack of confidence in expressing their ideas, making it difficult to determine the answer to a question.

This problem is reinforced by the results of the daily tests in IPAS and mathematics for fourth grade, which were presented by the class teacher in accordance with the Minimum Passing Criteria (KKM) at SDN 1 Wangunharja, which is 70. In Natural and Social Sciences (IPAS), the minimum score was 46, the average score was 63, and the maximum score was 86. Thus, at the end of the 2024 semester, there were still students whose literacy skills had declined, resulting in scores below average and below the MCC. Then, looking at the results of the daily mathematics tests, with a minimum score of 10, an average score of 40, and a maximum score of 90, it was also found that there were still students whose numeracy skills had declined, resulting in scores below the average and below the MPC. This is thought to be one of the causes of the hindrance of students' creativity and independence, resulting in a decline in their learning achievements.

The skills that students must possess in mastering social sciences and mathematics include the ability to use numbers, mathematical symbols, and calculation skills (Han, 2017). Numeracy is the knowledge and skills of (a) using various types of numbers and symbols related to basic mathematics to solve practical problems in everyday contexts, (b) analyzing information presented in various forms such as graphs, tables, maps, etc., and (c) using interpretation to predict and make decisions. Thus, the scope of numeracy includes 1) algebraic thinking (recognizing and analyzing patterns); 2) numbers (number sense, relationships between numbers), arithmetic operations); 3) geometry (spatial awareness, shapes); 4) measurement; and 5) data analysis (grouping, data presentation, probability) (Han, 2017). The quality of education in Indonesia still needs to be improved. The low literacy and numeracy skills of students are influenced by various factors, including the learning models and media used by teachers.

Teachers at SDN 1 Wangunharja rarely use electronic learning media in the learning process, so the learning models used at SDN 1 Wangunharja are still focused on lectures and assignments, and project-based learning models are rarely implemented, causing students to passively receive information and skills. To optimize student competencies, especially literacy and numeracy skills, educators should be able to utilize the available learning support materials and be creative in varying learning methods in line with technological developments in the era of globalization (Yani Suryani, 2018). Project-based learning can increase student participation and maintain student attention on learning objectives. This type of learning also provides opportunities for students to take action and become the center of learning by presenting them with authentic problems (Guo et al, 2020).

The project-based learning model is a learning model that focuses on student activities to understand a concept and principle by conducting in-depth research on a problem and finding relevant solutions, as well as enabling students to develop skills and knowledge through relevant and challenging projects (Dewi Fitriana, 2020). Therefore, teachers must design learning media according to the needs of students and the material presented. Project-based learning requires the application of appropriate learning media so that students can receive information from the lesson material well (Yuliawati, Didik, & Mustofa, 2020). In this study, one form of utilizing technological media in learning that suits the needs of students is an e-module on cultural diversity in Indonesia using PowerPoint and Canva applications to support successful learning. This media makes it easier for students to complete projects, engage in discussions, and encourages student participation.

An e-module is a form of teaching media that is systematically arranged into the smallest learning unit for independent learning purposes and presented in electronic format (Pratiwi, 2018). Electronic modules (e-modules) contain material, methods, limitations, and evaluation methods that are designed to be interesting and systematic in order to achieve the expected competencies. In line with its purpose, the use of e-modules is considered quite effective in improving student learning outcomes. In addition, e-modules do not require printing costs like hard copy modules (Nata, et al., 2023). The implementation of e-modules and PjBL learning models must also take into account the learning styles of students so that they are facilitated to develop their abilities at SDN 1 Wangunharja not only by using lecture and assignment methods but also through active and creative interaction methods.

Students who learn using their own learning styles can achieve better learning outcomes than those who learn using learning styles that are forced upon them and are not their unique learning styles. Therefore, teachers must consider these unique characteristics in order to maximize learning objectives and learning outcomes. Learning styles are a combination of how we absorb, organize, and process information. There are two styles of learning: 1) How we absorb information, 2) How we organize and process that information (Siregar et al., 2022). In line with the opinion of Supit et al. (2023), learning style is the way a person receives information using different levels of focus in order to obtain optimal learning outcomes. To date, Papilaya has identified three learning styles, as cited by De Potter (2016): visual (images), auditory (sound), and kinesthetic (practice/movement).

To support this research, the researchers used several references related to the influence of project-based learning on learning styles, literacy, and numeracy. Among them was the first reference from a journal conducted by Dyah Ambarwati and Meyta Dwi Kurniasih in 2021. This study found significant differences in using the problem-based learning (PBL) model in improving students' numeracy skills, which was then developed with reading and arithmetic skills in solving mathematical problems by the second researcher from a thesis in 2023 conducted by Nur Rafika Rahma entitled "Analysis of the Literacy and Numeracy Skills of Fourth Grade Elementary School Students in Solving Mathematical Problems." Based on the analysis of the data from these results, it was found that students' literacy and numeracy skills in solving mathematical problems had been implemented well.

Similar to the researcher, the study used quantitative methods with the difference being the use of a pre-experimental design and the use of PjBL assisted by e-module media reviewed from a learning style perspective. In the third study from the 2023 journal conducted by Dewi Fitriana entitled "Analysis of Science Learning Outcomes Reviewed from Learning Styles in the Problem Card-Assisted Project-Based Learning Model." The results of the research and discussion show that learning styles greatly facilitate the formation of students' understanding of science learning outcomes using the problem card-assisted project model, namely the creation of wall magazines and food chain posters. Similar to the researcher using PjBL, learning styles and quantitative methods, the difference is in the use of a pre-experimental design and e-modules as the learning media.

The fourth study conducted by Lee et al. (2023) shows that students with a kinesthetic learning style have higher literacy skills. Restiani (2022) also suggests that the project-based learning model can encourage students to actively engage in the learning process through real projects that require information seeking, collaboration, and reflection, thereby improving students' literacy skills. The sixth study conducted by Anugrah (2024) shows that students who use project-based learning (PjBL) have significantly improved numeracy skills

with an average score of 88.5. This is in line with the seventh researcher, Hutapea & Simanjuntak (2017), who found that students can also develop and improve their literacy in solving problems by processing sources, materials, and tools into real and meaningful projects.

The eighth study conducted by Hertinti (2023) suggests that project-based learning, when viewed from a learning style perspective, is highly effective in improving the numeracy skills of fourth-grade elementary school students. Based on these studies, which are mutually supportive and have strong contributions, it can be concluded that the project-based learning model, when viewed from a learning style perspective, can effectively influence students' numeracy skills. Similar to the researcher, they used the same quantitative research method and pre-experimental design, with the difference being that they used a saturated sample and e-modules as learning media. This study is relevant to that conducted by Fajri et al. (2024), which states that students' literacy skills are excellent when they receive project-based learning (PjBL) in measuring their literacy skills. There are students who read fluently and understand the content of the story very well so that they can interpret information through writing.

The average score for students' literacy skills is 89.5. Finally, research conducted by Mailani & Prasetyo (2022) states that project-based learning models significantly improve numeracy skills because they integrate skills and problem solving in real-life situations. Similar to the researchers who used the PjBL model, the quantitative method used a one-group pretest-posttest design and paired sample t-test data analysis technique. Based on previous studies, it can be concluded that various learning methods and media can improve student competence at the elementary school level and play an important role in supporting the formation of students' understanding, particularly in terms of better literacy and numeracy skills. However, most previous studies have examined Project-Based Learning or learning styles separately, with limited empirical evidence integrating e-module-assisted PjBL and learning styles simultaneously to examine both literacy and numeracy skills in elementary school contexts.

The novelty of the research in the review and sample that the researcher will conduct is that the researcher will examine students' literacy and numeracy skills in the learning process using an e-assisted project-based learning model -3D pop-up book modules, which are more attractive modules that include quizzes and 3D images to support the delivery of material reviewed from the learning style in learning that contains social studies and mathematics material for 4th grade elementary school students. "The beauty of my country's cultural diversity" can be beneficial in helping to overcome problems related to students' literacy and numeracy skills through projects assisted by e-modules reviewed from a learning style perspective.

The urgency of this research lies in the need to resolve the issues outlined above, both in general terms and in terms of the factual findings of researchers in the field, including Indonesia, which has one of the lowest literacy rates among several other countries. Many students still do not like to read books regularly and lack an understanding of basic mathematical concepts, including the ability to add, subtract, divide, and multiply in word problems. As a follow-up, this research is very important to carry out. Literacy and numeracy skills are essential for applying learning in everyday life in various real-world contexts. Literacy and numeracy skills are among the things that can accustom students to think more

critically and develop their capacity to be more courageous and confident, as well as to become better individuals (Arina, in Nur Rafika, 2023). The low literacy and numeracy skills of elementary school students need to be addressed and improved immediately through the provision of interesting learning media and the application of appropriate learning style strategies.

Therefore, this study aims to examine the effect of an e-module–assisted Project-Based Learning model reviewed from students' learning styles on elementary school students' literacy and numeracy skills. The objective is to develop the existing abilities and skills of students and provide a better understanding of mathematics through a project-based learning model assisted by e-modules, reviewed from a learning style perspective, in order to improve the basic abilities and skills of students so that their literacy and numeracy skills in elementary school can be improved. Therefore, this study focuses on identifying the extent to which e-modules can improve students' understanding of literacy concepts in theory, including reading and understanding information, as well as numeracy, which includes the ability to calculate and solve mathematical problems. This approach is designed to meet the learning style needs of students, whether visual, auditory, or kinesthetic, so that the material can be absorbed optimally by all students and encourage their interest in learning so that they can achieve optimal learning outcomes.

Based on the phenomena and several issues described above, as well as the results of observations, this study will differ from previous studies in terms of its object, subject, and learning focus. There is a new learning model and medium that can anticipate weaknesses in the learning process in terms of students' literacy and numeracy skills, namely the project-based learning model assisted by 3D pop-up book e-modules, viewed from a learning style perspective. In the learning process, various methods are integrated, such as lectures, discussions, and question and answer sessions, as well as utilizing a project-based learning model equipped with a 3D pop-up book e-module. The use of e-modules in a more attractive module display, as well as presenting quizzes and 3D images such as moving book displays or digital pop-up books created through PowerPoint and Canva applications, supports the delivery of material and the practice of digital project creation.

## **THEORETICAL FRAMEWORK**

### ***Model Project-Based Learning***

The Project Based Learning model is a student-centered learning approach that involves active participation in solving meaningful projects. Project Based Learning is understood as a learning model that engages students in the process of investigating real-world problems, enabling them to independently construct knowledge thru direct experience (Trianto, 2014). Project-based learning emphasizes the connection between academic concepts and real-life contexts. Project-Based Learning encourages students to understand learning concepts and principles thru exploration, collaboration, and reflection. This model provides students with the opportunity to develop critical thinking, problem-solving, and communication and collaboration skills thru challenging and relevant projects (Dewi Fitriana, 2023). The learning process begins with essential questions that guide students to integrate various disciplines into a unified learning experience (The George Lucas Educational Foundation, 2021).

The characteristics of Project-Based Learning include student involvement in decision-making, authentic problem-solving, collaborative work, continuous reflection, and assessment of the learning process and products. These characteristics enable the creation

of meaningful learning oriented toward the development of 21st-century skills (Darmadi in Nabilla, 2023). The theoretical foundation of Project Based Learning is based on constructivist learning theory, which views learning as an active process of constructing knowledge through experience and interaction with the environment. Project-based learning aligns with the principles of constructivism because it places students as active learners in constructing their understanding (Sefta Ayukanti, 2017).

### ***E-Modules in Project-Based Learning***

Implementing Project Based Learning requires flexible and adaptive teaching materials. Electronic modules or e-modules are digital learning materials systematically arranged to support independent learning by utilizing information technology (Pratiwi, 2018). The presentation of e-modules containing multimedia elements can increase learning motivation and strengthen students' conceptual understanding. E-modules have the characteristics of being self-instructional, self-contained, stand-alone, adaptive, and user-friendly, allowing learners to study at their own pace and according to their learning characteristics (Anwar in Fausih & Danang, 2015). Integrating e-modules into project-based learning provides easy access to materials, exercises, and project guides independently, thus supporting the achievement of learning objectives.

### ***Learning Style***

The differences in the individual characteristics of student participants in the learning process highlight the importance of understanding learning styles. Learning style is understood as the way individuals absorb, process, and organize information so that the learning process is more effective and meaningful (Irawati et al., 2021). Learning style preferences influence students' responses to the learning strategies and models applied (Siregar et al., 2022). Learning styles are generally classified into visual, auditory, and kinesthetic learning styles. Visual learning styles rely on sight and require visual displays to understand information. Auditory learning styles emphasize listening and discussion as the primary means of learning. Kinesthetic learning styles demand physical involvement and hands-on practice in the learning process (Kurniati et al., 2019; Wahyuni, 2017). Aligning Project Based Learning with students' learning styles allows for more optimal learning engagement. Project-based learning provides space for students to learn through observation, discussion, and integrated physical activities, thus accommodating differences in learning styles (Dewi Fitriana & Rahim, 2023).

### ***Literacy Skills***

Literacy skills are basic abilities that encompass the ability to read, write, speak, and listen in order to understand and process information. Literacy is understood as the ability to access, comprehend, evaluate, and effectively use information in various life contexts (UNESCO, 2020). Literacy is an important foundation in the learning process and the development of critical thinking skills (Nahdi & Yunitasari, 2019). Literacy skills indicators include the ability to identify main ideas, interpret text meaning, organize writing, and use appropriate and effective language. Project-Based Learning provides a contextual learning experience that allows students to develop literacy skills through exploration, discussion, and presentation of project results (OECD, 2018; Rahmah, 2023).

### ***Numeracy Skills***

Numeracy skills are an individual's ability to use number concepts and mathematical operations to solve problems in everyday life. Numeracy encompasses understanding

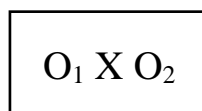
numbers, arithmetic operations, geometry, measurement, and data analysis in various representations (Han, 2017). Numeracy plays an important role in supporting logical and rational decision-making (Nurfitrani, 2024). Numeracy indicators include the ability to perform calculations, identify geometric shapes, and analyze data in real-life contexts. Project-based learning provides students with the opportunity to apply numeracy concepts directly thru solving authentic problems, making conceptual understanding more meaningful (OECD, 2018; Rahmah, 2023).

Based on the theoretical studies presented, Project Based Learning is seen as a learning model capable of improving the literacy and numeracy skills of elementary school students. Theoretically, Project-Based Learning provides meaningful learning experiences through authentic projects, while e-modules function as flexible learning resources that accommodate different learning styles. Visual, auditory, and kinesthetic learning styles are assumed to mediate students' engagement with project activities, which in turn facilitates deeper comprehension of textual information (literacy) and numerical problem-solving (numeracy). This theoretical relationship underpins the analytical framework of the present study. The effectiveness of this learning model is influenced by its suitability with the students' learning styles. Project-based learning integration, e-module support, and understanding learning styles serve as the theoretical foundation explaining the comprehensive influence of the learning model on literacy and numeracy skills.

## METHODS

### Research Design

This study employed a quantitative experimental research method using a pre-experimental design, specifically the one-group pretest–posttest design. This study employed a quantitative experimental research method using a pre-experimental design, specifically the one-group pretest–posttest design. This design is classified as pre-experimental because it does not yet fully control external variables that may influence the dependent variables (Sugiyono, 2019). However, the one-group pretest–posttest design allows researchers to compare conditions before and after treatment, enabling a more accurate estimation of treatment effects (Sugiyono, 2019). In this design, students were given a pretest ( $O_1$ ) prior to the treatment to measure their initial literacy and numeracy skills. The treatment ( $X$ ) was implemented through the project-based learning (PjBL) model assisted by e-modules, reviewed from a learning style perspective. After the treatment, students were given a posttest ( $O_2$ ) using the same instruments to identify changes in learning outcomes. An increase in posttest scores compared to pretest scores indicates a positive effect of the treatment.



**Figure 1.** One Group Pretest-Posttest Design Scheme

Explanation:

$O_1$  = Pretest score before treatment.

$O_2$  = Posttest score after treatment.

$X$  = Treatment.

The variables in this study consisted of an independent variable, namely the project-based learning model assisted by e-modules reviewed from a learning style perspective, and dependent variables, namely students' literacy and numeracy skills.

**Sample**

The population of this study consisted of 240 fourth-grade elementary school students from several schools. The sampling technique used was non-probability sampling, specifically saturated sampling, in which all members of the population were included as research samples (Sugiyono, 2019). This technique was chosen because increasing the sample size would not affect representativeness, as the sample already represented the entire population. The sample distribution included students from the following schools: SDN 1 Wangunharja (22 students), SDN 2 Wangunharja (25 students), SDN 1 Sitiwinangun (37 students), SDN 2 Sitiwinangun (27 students), SDN 3 Sitiwinangun (32 students), SDN 1 Bojong Wetan (35 students), SDN 2 Bojong Wetan (29 students), and SDN 3 Bojong Wetan (33 students).

**Data Collection**

Data collection techniques used in this study included observation, tests, questionnaires, and documentation. The test instruments consisted of literacy and numeracy tests, which were administered as pretests and posttests. The literacy test covered reading and writing aspects, while the numeracy test focused on number concepts, geometry, and data interpretation. In addition, a learning style questionnaire was used to identify students' dominant learning styles (visual, auditory, and kinesthetic). The questionnaire was arranged using a Likert scale and the instruments were tested for validity and reliability prior to data analysis to ensure measurement accuracy and consistency.

**Table 1.** Pretest and Posttest Literacy Question Grid

Aspect	Indicator	Grid	Level of Cognitive	Domain Question
Reading	1. Identifying detailed ideas in the text.	Examples of cultural diversity in Indonesia with their unique characteristics.	C2	1-3
	2. Interpreting the meaning of information.	The philosophical meaning of customs	C2	6
Writing	1. Organizing writing well with clear	The importance of preserving	C3	4-5

	and effective ideas in mind.	Indonesian culture		
	2. Using the correct and proper language.	Concluding and determining cultural diversity	C3	7-10
Total				10

**Table 2.** Pretest and Posttest Numeracy Question Grid

Aspect	Indicator	Grid	Level of Cognitive	Domain Question
Understanding number concepts and performing number operations.	Identifying and performing addition operations.	Mentioning the number of provinces in Indonesia and specifically on the island of Java.	C3	1-2
Using geometric concepts	Understanding the concept of angles, and flat shapes or geometric forms.	Determining the shapes of flat figures in batik pattern images, dance movement angles, and traditional houses.	C2	6, 7
Performing number operations and using statistical data concepts	Identifying data types in everyday life.	Determining statistical results in tables and graphs.	C2	3-5, 8-10
Total				10

**Table 3.** Learning Style Questionnaire Grid

Aspect	Indicator	Grid Statement	Visual	
			+	-
Visual	1. Neat and organized	1. Taking notes neatly and organized	1	
		2. Learning in a tidy environment		2

*Project-Based Learning Model*

		3. Paying attention to neatness in projects	2	5
	2. refers reading rather than being read	Prefers reading independently rather than listening to explanations from the teacher	3	
	3. Good long-term planner	Prepares for exams well in advance	4	
	4. Meticulous about details	1. Meticulous in doing questions		6
		2. Reviews answers before submitting	5	7
		3. Easily accepts material in the form of images	6	
		4. Difficulty remembering verbal instructions	7	
Auditory	1. Easily distracted by noise	Learns in a quiet environment		8
	2. Learns by listening and remembering what is discussed rather than what is seen	Learns by listening to explanations from the teacher	8	
	3. Likes to discuss and explains things in great detail	Explains things in great detail	9	
	4. Finds it difficult to write but is great at telling stories	Prefers telling stories rather than writing	10	9
Kinestetik	1. Learns by doing practice	Learns by doing questions and projects	11	0
	2. Always physically oriented and moves a lot	Responds to things with physical movement	13	
	3. Speaks slowly	Explains things to others slowly	14	
	Total			20

**Data Analysis**

Data analysis was conducted using statistical analysis techniques in accordance with the research objectives. Descriptive statistical analysis was used to describe students' literacy and numeracy skills, employing SPSS version 25 and Microsoft Excel 2010. Prior to hypothesis

testing, prerequisite tests were conducted, including normality tests and homogeneity tests. Hypothesis testing was carried out using paired sample t-tests to examine differences between pretest and posttest scores, as well as partial t-tests to analyze the effect of the independent variable on each dependent variable. These analyses were used to determine the effectiveness of the project-based learning model assisted by e-modules in improving students' literacy and numeracy skills.

## RESULT

### Descriptive Statistics

Here is a table of descriptive statistics calculated using SPSS V.25:

**Table 4.** Descriptive Statistics

		X <sub>1</sub> Style Learning	Y <sub>1</sub> Literacy Pretest	Y <sub>1</sub> Literacy Posttest	Y <sub>2</sub> Numeracy Pretest	Y <sub>2</sub> Numeracy Posttest
N	Valid	240	240	240	240	240
	Missing	0	0	0	0	0
Mean	70.35	42.88	76.33	43.46	71.21	
Median	75.00	40.00	80.00	40.00	70.00	
Mode	70	40	70	40	70	
Minimum	40	0	50	0	50	
Maximum	90	90	100	100	100	
Sum	15520	10290	18320	10430	17090	

Based on the table above, the descriptive statistics show differences between pretest and posttest mean scores for literacy and numeracy variables among 240 students, and the independent variables, namely students' literacy and numeracy skills, show a good difference in value improvement between the pretest and posttest scores of 240 elementary school students.

### Prerequisite Test

#### Normality Test

The following are the results of the normality test for this study using SPSS V.25 software:

**Table 5.** Results of the Kolmogorov-Smirnov Normality Test

Variable	Kolmogorov-Smirnov <sup>a</sup>		
	Statistic	df	Sig.
X <sub>1</sub> Style Learning	.051	240	.200*
Y <sub>1</sub> LiteracyPretest	.054	240	.090
Y <sub>1</sub> LiteracyPosttest	.055	240	.076
Y <sub>2</sub> NumeracyPretest	.056	240	.069
Y <sub>2</sub> NumeracyPosttest	.054	240	.086

\*. This is a lower bound of the true significance.  
a. Lilliefors Significance Correction

From the Kolmogorov-Smirnov normality test results above, it can be seen from the Sig. value for each variable X and Y, which is greater than >0.05, indicating acceptance. This means that the data is normally distributed and ready for analysis.

### Homogeneity

Test The following are the results of the homogeneity test for this study using SPSS Version 25 software:

**Table 6.** Homogeneity Test Results

Variable		Levene Statistic	df1	df2	Sig.
Y <sub>1</sub> Literacy Pretest	Based on Median and with adjusted df	.726	25	133.769	.823
Y <sub>1</sub> Literacy Posttest	Based on Median and with adjusted df	.932	25	153.226	.562
Y <sub>2</sub> Numeracy Pretest	Based on Median and with adjusted df	1.581	25	165.244	.548

Based on the table above, the results for each variable show significance values based on the median and with adjusted degrees of freedom. All of these significance values are greater than >0.05, so it can be concluded that the data for the variables meet the assumption of homogeneity. Thus, advanced statistical analysis for hypothesis testing can be performed validly.

### Hypothesis Testing

#### Hypothesis 1:

The following are the results of the hypothesis test using simple linear regression analysis obtained using SPSS Version 25 software:

**Table 7.** Results of the 1st hypothesis linear regression analysis test

Model		Unstandardized	Sig.
		Coefficients	
		B	
1	(Constant)	80.443	.000
	X <sub>1</sub> Style Learning	.824	.000

a. Dependent Variable: Y<sub>1</sub>Literasi

Based on the table above, the sig. value is <0.05, so H<sub>a</sub> is accepted, and the value of this constant is 80.443, indicating that students have an influence on the use of the project-based learning model on literacy skills, which is 80.44%. If there is no independent variable X (project-based learning) examined from learning styles, the value is 0% and there is no change. Here is the simple linear regression analysis generated for the Y<sub>1</sub> Literacy variable:

$$Y = a + bx$$

$$= 80,443 + 0,824x$$

Based on the above explanation, the learning style variable is 0.824, meaning that if learning style increases, literacy skills will also increase by 8.24%.

**Hypothesis 2**

The following are the results of the hypothesis using a simple linear regression analysis test obtained using SPSS Version 25 software:

**Table 8.** Results of the 2nd Hypothesis Linear Regression Analysis Test

Model		Unstandardized Coefficients		Sig.
		B		
1	(Constant)	57.079		.000
	X <sub>1</sub> Style Learning	.677		.000

a. Dependent Variable: Y<sub>2</sub>Numerasi

Based on the table above, the sig. value is <0.05, so H<sub>a</sub> is accepted, and the value of this constant is 57.079, indicating that students have an influence on the use of the project-based learning model on numeracy skills, which is 57.07%. If there is no independent variable X (project-based learning) considered from learning styles, the percentage is 0% or there is no change. Here is the simple linear regression analysis generated for the variable Y<sub>2</sub> Numeracy:

$$Y = a + bx$$

$$= 57.079 + 0.677x$$

Based on the description above, the learning style variable is 0.677, meaning that if learning style increases, numeracy skills will also increase by 6.77%.

**Hypothesis 3:**

Here are the results of the hypothesis using the paired sample t-test obtained using SPSS Version 25 software:

**Table 9.** Results of Paired Sample t-test for Hypothesis 3

Model		Mean	95% Confidence Interval of the Difference		df	Sig. (2-tailed)
			Lower	Upper		
Pair 1	Y <sub>1</sub> Literacy Pretest Y <sub>1</sub> Literacy Posttest	76.458	36.275	80.642	239	.000
Pair 2	Y <sub>2</sub> Numeracy Pretest Y <sub>2</sub> Numeracy Posttest	71.750	30.658	74.842	239	.000

Based on Table 9, it shows that there is a significant difference in the mean values between the pretest and posttest scores. This can be seen from the Sig. (2-tailed) value. If the significance value for each variable is less than <0.05, then H<sub>a</sub> is accepted. Based on the results of these three hypothesis tests, it can be concluded that this study shows a significant influence and difference in average values from the use of the project-

based learning model, viewed from learning styles, on the literacy and numeracy abilities of elementary school students.

## **DISCUSSION**

### ***The use of the project-based learning model viewed from learning styles toward literacy skills***

Based on the results of this study conducted in the fourth grade of elementary schools in the Jamblang sub-district, regarding students' literacy skills, there was an improvement. This was evident from field findings indicating that students were able to read and organize writing well, with clear and effective ideas in their minds, based on indicators used to measure literacy skills during the learning process. Based on the hypothesis test results, it also shows that each variable has a highly significant value. Based on this, it can be concluded that there is a very good influence on students' literacy abilities when using the project-based learning model, as viewed from learning styles. This research aligns with the findings of Fitriana (2023), who stated that learning styles can influence students' understanding, and project-based learning can improve literacy skills.

Another study by Fitriana & Rahim (2023) found that project-based learning, viewed thru the lens of learning styles, can train literacy skills, ensuring that learning is not passive and silent, but allows students to learn by moving, acting, touching, expressing themselves, collaborating, and discussing. Based on this, it is proven to be more effective when adapted to the project-based learning model, considering learning styles, whether visual, auditory, or kinesthetic, so that students are more interested in presenting project results, enjoy group discussions, and are more active in practical activities, which can influence students' literacy skills. As for the research conducted by Lee et al. (2023), it shows that students with a kinesthetic learning style have higher literacy skills. Restiani (2022) also stated that the project-based learning model can encourage students to actively engage in the learning process thru real-world projects that require information gathering, collaboration, and reflection, thus improving students' literacy skills.

This aligns with Hutapea & Simanjuntak (2017), who state that students can also develop and improve their literacy in solving a problem by processing resources, materials, and tools into a real and meaningful project. Based on this, it can be concluded that overall, there is a positive influence of Project-Based Learning on literacy skills. This improvement may be attributed to students' active engagement in authentic tasks that require reading comprehension, discussion, and project presentation, which align with their dominant learning styles and promote deeper cognitive processing. As for the research conducted by Larmer et al. (2020), it shows that project-based learning, when viewed from the perspective of learning styles, can improve students' literacy skills for active and independent learning thru projects, compared to students who do not use project-based learning (PjBL).

Grant et al. (2020) state that students' learning styles can play an important role in improving literacy skills, allowing students to learn comfortably according to their preferences. Another study by Guzdial et al. (2021) showed that students who learn with a kinesthetic learning style that meets their needs can improve their academic abilities. Based on this, it can be concluded that there is an influence of using the project-based learning model on students' literacy skills, viewed from their learning styles. Rahim (2023) shows that project-based learning, when viewed from the perspective of learning styles, can improve students' literacy skills, enabling them to learn actively and independently, build self-confidence, and gain a

sense of accomplishment thru project outcomes. This research aligns with the findings of Larmer et al. (2020), which showed that students using project-based learning have very effective and significant literacy skills.

Another study by Silver et al. (2022) found that project-based learning, viewed from the perspective of learning styles, is very effective in improving students' literacy abilities. Felder et al. (2018) showed that students with a visual learning style can better understand complex concepts. This research aligns with the findings of Krajcik et al. (2022), which also showed that project-based learning can improve students' literacy skills in an active and collaborative classroom environment. According to Septiary (2020), in the context of project-based learning (PjBL), literacy theory encourages students to access digital resources, collaborate in groups, and present project results thru presentations, videos, or narrative texts, leading to improvements in digital literacy, information literacy, and media literacy. Based on this, they mutually support each other and have good contributions.

Based on this, they mutually support each other and have a good contribution. Students are also able to obtain indicators to measure students' literacy abilities, namely reading and interpreting the meaning of text content to produce a project in classroom learning. This means that this research has proven the first problem formulation, which is that there is an influence of using the project-based learning model, viewed from learning styles, on the literacy abilities of elementary school students.

### ***The use of the project-based learning model viewed from learning styles toward numeracy skills***

Based on the results of this study conducted in the fourth grade of elementary schools in Jamblang sub-district, with students demonstrating excellent numeracy skills. This indicates an improvement in numeracy skills, as evidenced by field findings. Indicators were developed to measure numeracy skills during the learning process, and it was found that some students were able to calculate and analyze data in the form of geometric shapes and graphs. Based on this, it shows that there is a significant improvement in enhancing students' numeracy skills using the project-based learning model, as viewed from their learning styles. This research aligns with the findings of Rahma (2023), which showed that students' literacy and numeracy skills in solving mathematical problems are already well-developed. This theory is also consistent with the findings of Felder et al. (2018), who also showed that students with a logical-mathematical learning style can be more active in understanding numeracy concepts involving measurement and solving problems with arithmetic operations.

As for the research conducted by Suhartini (2022), it shows that students who learn using the project-based learning model, considering their learning styles that suit their needs, can improve their numeracy skills by discovering mathematical problem-solving concepts, calculating and analyzing statistically, and producing projects in the form of geometric shapes or graphs that are useful in the context of real-life situations. This theory, developed by Hertinti (2023), proposes that project-based learning, when viewed from the perspective of learning styles, is very effective in improving the numeracy skills of fourth-grade elementary school students. Based on the research, which mutually supports and has a strong contribution, it can be concluded that the project-based learning model, viewed from learning styles, can influence students' numeracy skills, leading to a significant improvement in the learning process to build student activity and enable them to learn real-life contexts that require numeracy knowledge.

Latifah (2023) stated that students with a kinesthetic learning style have higher numeracy skills compared to students with a visual learning style. As for the research conducted by Diana (2022), it shows that project-based learning can improve students' numeracy skills through active learning to process information with mathematical problem-solving in interpreting numbers, graphs, data, tables, and diagrams. Based on this, it can be concluded that project-based learning, from the perspective of learning styles, is very effective in improving students' numeracy skills. As for the research conducted by Anugrah & Wulandari (2023), it shows that there is an influence of using the project-based learning model on numeracy skills, which emphasizes students to engage in exploratory, collaborative, and problem-based mathematical activities, thus encouraging students to be directly involved in the numeracy learning process through real-world projects.

This finding is supported by Nugroho (2023), who stated that project-based learning, when viewed from the perspective of learning styles, can improve students' numeracy skills in the classroom by facilitating active learning through e-book projects. Based on this, it can be concluded that the project-based learning model, when viewed from the perspective of learning styles, can play an important role in improving students' numeracy skills in the era of globalization and the increasing advancement of technology. Puspitasari (2024) states that this project-based learning model uses projects as the central activity of learning, which can enhance numeracy skills by fostering students' enthusiasm for learning and encouraging them to independently seek information to solve mathematical problems, thus actively acquiring knowledge during the learning process. Nina (2023) suggests that the project-based learning model, when viewed from the perspective of learning styles, can also play an important role in improving numeracy skills.

As for the research conducted by Lee et al. (2018), it also shows that project-based learning is very effective in improving the numeracy skills of fourth-grade elementary school students. The field findings indicate that students' numeracy skills are enhanced as they become more active in seeking mathematical problem-solving concepts through projects, from calculation methods to producing works in the form of flat geometric concepts. Devi (2024) shows that students with different learning styles experience an increase in numeracy skills when the project-based learning model, which is responsive to their learning preferences, is applied. Flexible project activities allow students to find their own learning strategies for understanding basic mathematical concepts such as comparison, measurement, and addition and multiplication. Kusumaningrum et al. (2024) support the idea that success in numeracy learning depends not only on the material but also on how students interact with numerical tasks according to their learning situation.

This finding aligns with research conducted by Mailani & Prasetyo (2022), which states that project-based learning models significantly improve numeracy skills because they integrate skills and problem-solving in real-world situations. Khusna & Septikasari (2025) found that implementing the project-based learning model in mathematics instruction helps students understand concepts through real-life contexts, particularly in numeracy skills, which are developed integrally through the completion of meaningful projects. As for the research conducted by Hidayati et al. (2024), it shows that there is an increase in the understanding of IPAS and mathematics concepts for students with the application of the project-based learning model assisted by interactive e-modules. Based on this, it can be concluded that learning using the project-based learning (PjBL) model from year to year helps students

understand numeracy concepts with the aid of interactive media and produce tangible projects.

As for the research conducted by Faridah et al. (2022), it showed that the effect observed in the experimental class receiving the project-based learning (PjBL) model treatment was superior to the control class using the conventional learning model in terms of numeracy skills. Eriza & Hadi (2023) also show that the project-based learning model is very effective and has had a beneficial impact on the development of students' numeracy skills in mathematics. Another study developed by Yanti & Novaliyosi (2023) states that the project-based learning model has a positive impact on improving both hardskills and softskills in elementary school mathematics learning. Based on this, as well as the very supportive and strong findings in the field that contribute to proving the second problem formulation, there is an influence of using the project-based learning model viewed from learning styles on the numeracy abilities of elementary school students.

***Differences in the average literacy and numeracy scores of students after using the project-based learning model, viewed from learning styles***

Based on the results of this study conducted in class IV of elementary schools in the Jamblang sub-district, with students' literacy and numeracy abilities at the time of the pretest and posttest showing very significant average scores after using the project-based learning model, viewed from learning styles. This indicates an improvement in literacy, as evidenced by field findings that provide indicators for measuring literacy skills. During the learning process, some students were able to read and organize their writing well, with clear and effective ideas, and were also capable of solving numerical problems. This research aligns with the study conducted by Nurhadiyah et al. (2020) on the influence of the project-based learning model on the literacy and numeracy abilities of elementary school students, which found an improvement in students' literacy and numeracy skills, including a liking for reading and identifying story problems to interpret information, as evidenced by an increase in students' average scores.

As for the research conducted by Hwang et al. (2020), it shows that students who learn using the project-based learning model, considering their visual, auditory, and kinesthetic learning styles that suit their needs, can significantly improve their literacy and numeracy skills. Based on this, it can be concluded that the project-based learning (PjBL) model is effective in improving the literacy skills of elementary school students. As for the research conducted by Fajri et al. (2024), it states that students' literacy and numeracy abilities have a very good average score, with indicators in measuring students' literacy abilities showing that some students are fluent in reading, counting, and very understanding of the content of story problems, allowing students to interpret information thru writing and process data well and correctly. Ambarwati & Kurniasih (2021) found a significant difference in the use of the project-based learning model in improving students' numeracy skills for calculation.

Then, this theory was developed with reading and arithmetic skills in solving mathematical problems by Anugrah (2024), which showed that students using project-based learning had significantly improved literacy and numeracy skills, as evidenced by the significant difference in average scores. This research is also consistent with the hypothesis testing conducted by Rohim & Nugraha (2023), which showed a significant difference between the literacy and numeracy abilities of students using project-based learning (PjBL) and those using problem-based learning (PBL). Students with visual learning styles, such as compiling reports, creating

presentations, and producing products according to their learning preferences, tend to achieve higher average improvements in literacy and numeracy skills compared to other groups (Lee et al., 2023). As for the research conducted by Ali et al. (2023), it states that the significant advantage of the kinesthetic group in improving literacy and numeracy skills using the project-based learning model can strengthen active and experiential learning, which is very effective for mathematical skills at the elementary school level.

This finding is consistent with the work of Safira et al. (2025), which found a significant difference in the average values of project-based learning characteristics in numeracy, requiring students to perform practical applications such as measurement, scale modeling, material cost calculation, and manipulation of real objects, which is the dominant learning preference of the kinesthetic group. Based on this, it can be concluded that literacy and numeracy skills, and the patterns of differences found in this study using the project-based learning model, when viewed from learning styles, show a very significant average value. During the direct research with field findings in the classroom learning process, students were more enthusiastic and active in using projects to solve both theoretical and mathematical problems, resulting in significant improvements in their literacy and numeracy skills. For example, the indicators achieved were that students could understand text, geometric shapes, and arithmetic operations after being given the project-based learning model.

## CONCLUSION

Based on the research conducted on fourth-grade elementary school students in Jamblang sub-district using a one-group pretest-posttest design and descriptive statistical calculations, simple linear regression tests, and paired sample t-tests, significant differences were found in the pretest-posttest average scores. It can be concluded that: (1) The project-based learning model, viewed from the perspective of learning styles, significantly influences the literacy abilities of elementary school students with a very good level of proficiency; (2) The project-based learning model, viewed from the perspective of learning styles, significantly influences the numeracy abilities of elementary school students with a very good level of proficiency; (3) The project-based learning model, viewed from the perspective of learning styles, can improve students' literacy and numeracy abilities, with a significant difference in average scores between pretest and posttest. Based on statistical results and field findings, the project-based learning model, viewed from the perspective of learning styles, has a very positive impact on students' literacy and numeracy skills. Practically, these findings suggest that elementary school teachers should integrate project-based activities supported by interactive e-modules that accommodate diverse learning styles. Future studies are recommended to employ quasi-experimental or mixed-method designs and involve broader participant groups to strengthen generalizability.

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