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THE INFLUENCE OF THE PROJECT BASED LEARNING MODEL (PjBL) AND DIGITAL LITERACY ON CRITICAL THINKING ABILITIES OF GRADE V STUDENTS IN SCIENCE SUBJECTS IN ELEMENTARY SCHOOL

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ABSTRACT

Based on the findings, it became clear that the fifth-grade students at SDN Tomang 03 did not demonstrate optimal critical thinking abilities in their science classes. The teachers had not fully implemented engaging and innovative teaching methods, which led to the students' low critical thinking skills in this subject. This research aims to explore and describe how the PjBL model impacts critical thinking skills. Additionally, it seeks to assess the effect of digital literacy on those skills. The research employs a non-equivalent control group design, functioning as a quasi-experiment. For this study, the complete population of two classes was utilized as a sample through a saturated sampling method. The experimental group engaged with the PjBL learning approach, whereas the control group followed a direct instruction model. Data was collected using a multiple-choice assessment. This assessment was administered to students in classes VA and VB at SDN Tomang 03. A two-way ANOVA test was used for data analysis. The study's findings indicate a significant effect between the PjBL learning model and the critical thinking abilities of the students, with an Fcount > Ftable 5.97 > 4.139, leading to the rejection of H0 and acceptance of H1. Furthermore, the impact of digital literacy on students' critical thinking skills was also significant, with an Fcount > Ftable 33.41 > 4.139, resulting in the rejection of H0 and acceptance of H1. Therefore, digital literacy positively influences students' critical thinking skills. As students' digital literacy increases, their critical thinking abilities also improve. The PjBL approach can be combined with digital literacy to further capture students' interest in learning in the classroom.

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1. INTRODUCTION

21st-century education combines knowledge, skills, attitudes, and the ability to use technology, information, and communication. These technological advances require transformations across every area of existence, especially in learning in schools. For students to succeed in the 21st century, learners need to develop essential abilities linked to the four

foundations of life: gaining knowledge, acquiring skills, personal development, and coexisting. These foundations encompass abilities like analytical thinking, resolving issues, self-awareness, effective communication, collaboration, originality, creativity, and the ability to interpret information. Among these, critical thinking stands out as the key educational skill of our time. Students should be capable of analyzing information critically, integrating different kinds of data, reflecting on diverse viewpoints, and finding solutions to challenges (Rochmatika & Yana, 2022). These skills are important for students in today's digital era so they can think critically and solve problems effectively wherever they are.

Critical thinking is an advanced cognitive ability (Hamdani M et al., 2019). The challenge in education is to require students to engage in advanced thinking (HOTs). In the context of science education, reasoning abilities are crucial for learners to effectively tackle challenges encountered in conducting an experiment. According to (Cottrell 2005) in (Hamdani M et al., 2019), critical thinking refers to the capability to accurately resolve an issue, assess, and deeply analyze the choices made. It is an advanced cognitive skill that is vital for students to cultivate. Navigating a continually evolving world demands a culture of critical thinking among individuals. For this reason, the primary focus of education is to instruct students in the art of learning and thinking critically. The concept of critical thinking is complex and encompasses complex activities and mental processes. The critical thinking process is not easily described (Vacek, 2009) in (Rahardhian, 2022).

Although critical thinking is complex, it does not mean it cannot be developed. Critical thinking can be developed through its application in learning. Knowing the fact that critical thinking skills have been developed since ancient times through philosophy, now critical thinking skills are increasingly needed, as one of the abilities important in the 21st century. Education in schools aims to develop students' critical thinking skills. Education involves more than just sharing information; it also nurtures students' intellects so they can tackle challenges and think innovatively. This critical thinking ability cannot be replaced by technology. A study (Ningsih et al., 2023) shows that educators still use teacher-centered models and methods, such as lectures without Q&A. Teachers also haven't fully utilized technology to achieve learning objectives. Teachers also haven't fully utilized innovative learning media. As a result, learning becomes monotonous, and students don't have many opportunities to reach their potential. Furthermore, during classroom practice, students also lose their critical and imaginative thinking skills.

According to (Mujahida & Rus'an, 2019) in a learning approach that focuses on students, the teacher's job is to assist learners in uncovering information, ideas, or rules independently.. Teachers can provide students with ladders that can help them reach a higher level of understanding, but efforts must be made to ensure that students climb the ladder themselves, rather than giving lectures or controlling all student activities. If knowledge is only transferred, by educators only explaining material one material at a time, PowerPoint page by PowerPoint, it is the educator who becomes smart. Consequently, to indicate the educational initiatives aimed at developing creative, engaging, innovative, and inspiring student personalities along with critical thinking within classroom learning, it is essential to adopt a student-focused learning strategy. Research by Trends in International Mathematics and Science Studies (TIMSS), which was conducted to evaluating students' critical thinking abilities using advanced cognitive questions demonstrates that the critical thinking skills of students in Indonesia remain low.

Findings from the research indicate that Indonesian students regularly appear at the lower end of the rankings. They placed 35th among 46 nations in TIMSS 2003, 36th out of 49 nations in TIMSS 2007, and 38th from a pool of 42 nations in TIMSS 2011 (P4TK, 2011), and 44th out of 49 nations in TIMSS 2015. (Lestari Pratiwi & Akbar, 2022). The survey results show that Indonesian students have not been capable of addressing issues that need advanced cognitive abilities, including critical thinkng skills. Based on observations and interviews conducted on April 18, 2024, with the fifth-grade homeroom teacher of Tomang 03 Elementary School, West Jakarta, students appeared to have good critical thin This was evident in how students applied their analytical skills when solving problems or answering questions. Their limited critical thinking abilities resulted from a lack of teacher support in fostering and developing these skills during the learning process, but some students had low critical thinking skills.

A factor believed to play a role in the lack of critical thinking abilities is the inadequate level of literacy among the public. One way to address this problem is through digital literacy. Everyone should continuously strengthen their critical thinking to reason logically and confidently. The purpose of using digital media, including smartphones, laptops, computers, and other electronic devices, is to help the general public access information quickly (Rochmatika & Yana, 2022). With the help of digital media, it is hoped that we can achieve educational goals and keep up with 21st-century developments, which require students to strengthen their digital literacy and critical thinking skills. Additionally, educators must have the ability to choose and apply teaching methods that promote students' active enhancement of digital literacy and foster advanced thinking skills, such as critical thinking. One effective learning approach that can cultivate students' critical thinking abilities and digital literacy is the use of the PjBL model.

PjBL is a learning approach designed to create an environment that empowers students to construct their own understanding and skills by engaging in activities that result in meaningful, tangible outcomes aligned with the learning objectives (Maulita et al., 2023). According to (Anggraini & Wulandari, 2020), the PjBL approach is widely recognized as a teaching method that integrates problem-based learning to help students better understand and apply theoretical concepts. This model employs a contextual method and encourages students to think critically, allowing them to evaluate the most suitable choices for addressing challenge. Considering the pros and cons of a decision used to solve a problem is also included in the theory. The PjBL learning model has a final project goal or activity outcome as its ultimate goal. This learning model still follows learning outcomes and the curriculum and focuses on students' activities gathering information and utilizing it to produce a project (Azhari et al., 2023). To ensure lasting retention of students' memories of the lesson, learning must encourage students to actively link related concepts to the ongoing material.

An active learning process must involve learning media to the maximum to stimulate student activity. Students should not only create products as the final result of solving the problem, but also be active in improving existing concepts or problem solving, so that the standard of the process learning outcomes can be seen (Azhari et al., 2023). Simply put, this PjBL model links existing technology with familiar environmental conditions around students or projects found in schools so that the student's learning experience seems interesting and useful. According to (Alhayat et al., 2023) states that the PjBL model is a teaching approach that emphasizes the core ideas and fundamentals of a subject, engages learners in tackling problems and taking on significant assignments, allows students to independently develop their understanding, and results

in worthwhile and authentic outputs from students. Therefore, this PjBL teaching method can lead to deeper learning, as students not only grasp the material being taught but also recognize the value of the learning through project work, both for their own growth and for their community.

Several previous studies have applied the PjBL approach to improve students' critical thinking and digital literacy skills, although such research remains relatively limited. For example, research (Faridah et al., 2022) on the Learning Effectiveness of the PjBL Model PjBL, The Influence of Numeracy Literacy and Digital Literacy on Primary Madrasah Students. Then research (Rajah et al., 2023) about the Influence of Digital Literacy with Learning Models PjBL on Students' Learning Enthusiasm in Informatics Learning. Then, research (Suminarsih, 2023) on Improving Understanding of Physics Concepts and Digital Literacy Skills Through Video Using PjBL. Based on research above, there are similarities and differences between the studies that the researchers will conduct. This study utilizes the PjBL approach to support students in the learning process become more digitally literate and think critically. However, there has been little research on how this learning model works. PjBL and digital literacy can help students become more critical thinkers in elementary school. Research has been conducted primarily on junior high school, high school, and even college students. Furthermore, there are differences in the type of material, time, location, and sample size.

The researcher himself wanted to explain the impact of PjBL learning and digital literacy on students' critical thinking skills and their application in elementary school learning to provide clearer information for elementary school teachers who are required to master technology. What is new in this study is that it was conducted on fifth-grade elementary school students and focused only on the science subject "Harmony in Ecosystems," not the entire subject. This research intends to examine, assess, and identify the impact of the PjBL learning model on the critical thinking abilities of fifth-grade students in the science course at SDN Tomang 03. Furthermore, it seeks to analyze, evaluate, and establish how digital literacy skills affect the critical thinking capabilities of fifth-grade science students at SDN Tomang 03. Additionally, the study will investigate, evaluate, and clarify the interaction between the PjBL learning model and digital literacy in relation to the critical thinking skills of fifth-grade students studying science at SDN Tomang 03.

2. METHOD

The technique employed for this investigation is quantitative research. This form of investigation is experimental in nature, utilizing a quasi-experimental strategy along with a quantitative perspective. A quasi-experiment is characterized as an experimental study that involves a treatment, methods for measuring effects, and subjects for experimentation, but does not incorporate random assignment. (Abraham & Supriyati, 2022). This research seeks to uncover cause-and-effect links by including a control group alongside the experimental group, although the division between the two groups is not done randomly. In summary, the purpose of this research is to observe the impact of the implemented manipulation. The extent of its influence will be calculated using statistical analysis. Quantitative data analysis techniques are used to analyze quantitative data, namely number-based data, both categorical and numerical data. This method of analyzing data can be categorized into two types: descriptive quantitative analysis and inferential quantitative analysis. The research design uses a 2x2 factorial design. This design aims to test (validate), namely to test the effect of one or more variables on other variables. This study has

three variables consisting of two variables and one dependent variable. The variable being tested in this research is the Learning Model. PjBL and digital literacy, along with one outcome variable, critical thinking abilities. The group studied consisted of 45 fifth-grade pupils from SD N Tomang 03, in the 2024/2025 academic year. They consisted of 20 male students and 25 female students. The population was divided into two classes. Experimental group A in this study, namely class VA, consisted of 23 students who received treatment using learning PjBL, while experimental group B, namely the group of 22 class VB students who received treatment utilizing the straightforward learning approach. Thus, the sample used was 45 students as respondents.

3. RESULTS AND DISCUSSION

3.1 Prerequisite Analysis Testing

1. Normality Test

The normality assessment in this research was carried out with the Liliefors method. Based on the critical thinking ability test data in the experimental class, namely group A1B1, Lhitung = 0.116 was obtained at a significance level (α) = 5% with Ltabel = 0.234. Meanwhile, the critical thinking ability test data in the control class, namely group A1B2, Lhitung = 0.189 was obtained at a significance level (α) = 5% with Ltabel = 0.300. Meanwhile, the critical thinking ability test data in the control class, namely group A2B1, Lhitung = 0.189 was obtained at a significance level (α) = 5% with Ltabel = 0.300. = 0.245 at a significance level (α) = 5% with L_{table}= 0.258. Meanwhile, the critical thinking ability test data in the control class, namely group A2B2, obtained Lhitung = 0.115 at a significance level (α) = 5% with L_{table}= 0,300 in Table 1.

Table 1. Results of Data Normality Test

Group	N	Count	Table	Criteria	Information
A1B1	13	0,116	0,234	List < Table	Normal
A1B2	7	0,189	0,300	List < Table	Normal
A2B1	10	0,245	0,258	List < Table	Normal
A2B2	7	0,115	0,300	List < Table	Normal

Based Table 1 on data 4 (four) variants, the L $value_{count}$ critical thinking ability is smaller than Ltable, it can be determined that the information follows a normal distribution.

2. Homogeneity Test

The homogeneity test in this study was conducted using the Bartlett test with a threshold of significance set at 5% (α = 0.05) to determine the variance of the data from the four groups studied. The results of the homogeneity test for each class are described as follows in Table 2:

Table 2. Homogeneity Test Result Data

Group	db	V	X^2count	X^2table	Criteria	Information

A1B1	13	120.859				Homogeneous
A1B2	7	194.143	0,612	7.815	X^2count <	Homogeneous
A2B1	10	169.067			X^2table	Homogeneous
A2B2	7	234.286				Homogeneous

In the Table 2 according to the information presented in the graph above, one can infer that the difference in the data (fourth) is distributed homogeneously because X^2count < X^2table with a value of 0.612 < 7.815.

3. Hypothesis Submission

In this study, the researcher used Ms Excel 2019 to analyze the data (two-way ANOVA). The following test results are as follows the Table 3:

Table 3. Results of Two-Way ANOVA Analysis

S. Variants	JK	db	RJK	Number of F	(a = 0,05)	Criteria	Information
Between A	1002,9	1	1002,9	5,97	4.139	Fh (A) > Table F	H0 rejected, H1 accepted
Between B	5612,16	1	5612,16	33,41	4.139	Fh (B) > Table F	H0 rejected, H1 accepted
AxB Interaction	-45,56	1	-45,56	-0,27	4.139	Fh (AB) < Table F	H0 accepted, H1 rejected
Inside	5542,48	33	167,95				
Total	12112,0	36					

3.2 Discussion

PjBL is a creative educational model that focuses on learning within real-world contexts through intricate tasks. In this approach, students are more engaged, while educators guide and assess its relevance and use in daily situations. Students are instrumental in enhancing their skills, aligning with the concept proposed by (Sudirman et al., 2023) which states that PjBL offers a cooperative and student-centered learning environment, where students work together in groups to complete projects related to real-world problems. In this study, students engaged in PjBL have the chance to enhance their analytical abilities, problem-solving skills, and decision-making capabilities, which are all crucial components of critical thinking. PjBL also creates an environment for students to take an active role in their education, fostering deeper and more creative thinking. According to (Khafah et al., 2023), PjBL actively engages students in addressing issues that are pertinent to their daily lives. Additionally, while working on a project, learners typically feel a sense of ownership, which naturally leads them to engage in activities related to problem-solving, making decisions, or conducting investigations.

This approach allows students to gain independence in creating outcomes through the

educational process. Projects are characterized by innovation, creativity, and enjoyable learning experiences. Data analysis conducted by researchers indicates that the critical thinking abilities of students in classes utilizing the PjBL model are superior to those of students in classes employing traditional teaching methods. The aspect of PjBL that most significantly impacts critical thinking skills occurs during the initial phase, which begins with essential questions. In this phase, students are prompted to respond to important questions by identifying ecological issues in their local environment, examining the underlying causes of these issues, and then developing alternative strategies to address them. In the experimental group, the PjBL learning model is implemented by providing instructional content. and examples of making a poop-up book project related to animal ecosystems so that students can understand learning about animal ecosystems through LKPD by making a poop-up book on the ecosystem and a learning video about the ecosystem that has been made by the teacher about PjBL.

In this lesson, the teacher directs students to complete the assigned project based on the previously explained concept related to the animal ecosystem. Students gain learning experience after applying the PjBL model relevant to critical thinking skills. The learning achievement achieved by students in this study is the ability to make a poop-up book project about the animal ecosystem. The initial stage of the PjBL model. This involves providing stimulus to students by providing learning videos about the ecosystem in their environment. The teacher provides opportunities for students to share examples of ecosystems in their environment. Students then gathered information about ecosystems in study groups. Students began by watching a video provided by the teacher about how to make an ecosystem poop-up book in one group. Then, students began to prepare the necessary equipment and materials, and in groups students began to make a poop-up book about the ecosystem. In the last phase, learners were requested to share the outcomes of their conversations by demonstrating hem to other teams, and then collectively formulate conclusions based on the knowledge they had acquired.

Students who are accustomed to learning using PjBL also indirectly train their analytical abilities. Educational tasks conducted in the experimental class provided opportunities for students to create learning projects related to harmony in the ecosystem, namely making a poop-up book about animal ecosystems. Students watched a video on how to make a poop-up book about animal ecosystems then students began to make an ecosystem poop-up book in groups. While working in groups, some students were not yet active and some did not understand the ecosystem poop-up book, after the teacher began to guide in learning and making the ecosystem poop-up book, students began to be able and understand what a poop-up book is and how to make it. Next, each group takes turns presenting the results of their projects, while each group responds and confirms their accuracy. This allows students to draw conclusions about the material taught together without relying on the teacher. In the implementation of PjBL, students are more active in paying attention to the material and working in groups to create projects.

The teacher in PjBL guides the learning process and can provide examples of ecosystems in everyday life in the students' environment. In PjBL learning, students' ability to think critically can be enhanced by answering questions given by the teacher at the beginning of the lesson through worksheets and videos, where students are asked to state what they know from authentic questions given related to the material of harmony in the ecosystem. Moreover, the ability of students to think critically improves when they work together on projects related to animal ecosystems, such as pop-up books. The implementation of all PjBL learning steps that are carried out clearly identify

the roles of teachers and students during the learning process, students get involved in their own learning, which helps them develop better thinking skills. Based on the constructivist idea behind the PjBL learning model, students build their understanding through real-life experiences and working with others. according to (Khafah et al., 2023). In this study, students in the experimental class were involved in projects relevant to everyday life, so they could connect theoretical concepts with practical applications.

In contrast to the learning process in the experimental class, students in the control class were given lesson materials directly without being given projects. Students in the control group received direct instruction, which focused on the teacher giving information verbally to the students in order to help them understand and learn the material. Direct instruction is a teaching method where the teacher takes the main role in delivering the lessons. In this learning model, the teacher plays a very dominant role. The main focus of this learning is the academic abilities of students. Direct learning focuses on the teacher speaking directly to students to teach information, and the goal is to help students understand and learn the material thoroughly. Direct learning tends to be monotonous because students are more passive and only wait for the material provided by the teacher. Students do not develop their abilities, including critical thinking skills, because they only follow the teacher's instructions and directions, rather than following their own learning styles.

With the direct learning process, students become more passive in learning because they only rely on the material provided by the teacher. In general, the PjBL model prioritizes student learning experiences so that learning is more meaningful, while the direct learning model emphasizes mastery of concepts that can change student behavior with the help of the teacher through lectures, assignments, and demonstrations. Based on this, students who learn with the PjBL learning model develop stronger critical thinking skills compared to students who learn through the direct learning model. This research groups digital literacy into three levels: low, medium, and high. However, only low and high digital literacy data were analyzed, while moderate digital literacy was not analyzed because it was considered neutral. There are differences between students' digital literacy for PjBL learning and direct learning. In PjBL, students are faced with problems or challenges that must be solved. The application of digital literacy as an effective learning support in the classroom helps students understand the learning and make the right decisions.

Digital literacy plays an important role in enhancing students' critical thinking abilities. This indicates that students with stronger digital literacy skills generally demonstrate better critical thinking skills compared to those with weaker digital literacy. Digital literacy equips students with the ability to access, evaluate, and use information critically, which is a crucial aspect of fostering critical thinking skills. The findings of this study reveal that digital literacy significantly impacts students' critical thinking abilities. This aligns with the digital literacy theory proposed by (Handayani, 2020), digital literacy involves the capacity to access, evaluate, create, and use information in a thoughtful and critical manner. Digital literacy goes beyond just knowing how to use technology; it also involves the ability to understand and think carefully about information. In this study, students who have better digital literacy can use technology to look closely at information, which helps them develop their critical thinking abilities. According to (Ebyatiswara Putra et al., 2023), digital literacy means being able to find information online, understand websites as they change, and collect knowledge from different digital sources.

These abilities greatly contribute to the development of critical thinking skills because students are taught to identify relevant information, evaluate the credibility of sources, and apply data in a logical way to reach solutions. In this study, students who possess strong digital literacy skills showed improved critical thinking abilities because they were able to use technology effectively to understand and solve problems. The results of this study align with previous findings that highlight the importance of digital skills in fostering critical thinking. (Faridah et al., 2022) which show that digital literacy contributes significantly to the development of students' cognitive skills, including critical thinking. Another study by (Suminarsih, 2023) found that digital literacy contributed 49.80% to students' critical thinking skills. This study strengthens the evidence that digital literacy is not only a technical tool, but also an important foundation in building students' analytical and evaluative skills. This, the results of this study support the view that digital literacy is a key element in improving the quality of education in the digital era.

In the application of digital literacy, students in the experimental and control classes were asked questions about their use of computers and devices. Because students were already accustomed to using devices, they appeared to have no difficulty answering questions about the use of digital literacy in everyday life. In this study, there was a difference in the average (mean) scores in the experimental and control classes for measuring critical thinking skills with two (2) categories of digital literacy: low and high digital literacy. In the experimental class, the PjBL model was implemented, whereas the control class followed the direct learning approach. The average value (mean) in the control class with low digital literacy was 44.57, while in the experimental class with low digital literacy was 59.86. Meanwhile, the average value (mean) in the control class with high digital literacy was 74.8, while in the experimental class with high digital literacy was 79.77. This means that when teaching and learning activities apply the direct learning model but students in that class have high digital literacy, while when teaching and learning activities apply the PjBL model but students in that class have low digital literacy, then the effect on critical thinking skills is not significant.

Based on the calculation of hypothesis III, F is obtained$_{count}$ = -0.27 and F$_{table}$= 4.139 with numerator db = 1, denominator db = 36 and significance level = 0.05. When compared between F$_{count}$ with F$_{table}$obtained a value of -0.27 < 4.08 or F$_{count}$ < F$_{table}$then it can be concluded that H$_0$ accepted and H$_1$ rejected, which means there is no interaction between the PjBL model and digital literacy on the critical thinking skills of fifth-grade students at SDN Tomang 03. This can be proven when the PjBL model and direct learning model are applied, not all students with high digital literacy have high critical thinking skills; some students have low critical thinking skills. The same thing also applies in the application of PjBL and direct learning models, not all students who have low digital literacy have low critical thinking skills, there are some students who have high critical thinking skills. In other words, the influence of digital literacy on students' critical thinking skills does not depend on the type of learning model used. The results of this study indicate that students' critical thinking skills are not significantly influenced by the interaction between the PjBL learning model and digital literacy.

This can be explained through the critical thinking theory put forward by Ennis (1996) in (Saputra, 2020), which states that critical thinking involves the process of analyzing, evaluating, and concluding information logically and systematically. In this context, although PjBL provides a project-based learning experience that supports the development of critical thinking skills, digital literacy, as an independent factor, is quite effective in helping students access, evaluate, and use

information to support critical thinking processes. Thus, both approaches can operate independently without significant interaction. In science learning, students need a comprehensive understanding of the material presented by the teacher. Teachers are a crucial component in student success in teaching and learning activities. Teachers have professional skills in using appropriate learning models. As educators, they must also master the material they present and be skilled at creating engaging teaching situations and conditions when delivering the material. One material that can stimulate students' interest in the learning material presented by the teacher and train them to be more creative is a learning model. PjBL is useful for material development. This PjBL model also serves as a learning process for creating their own learning media by creating a pop-up book ecosystem learning project. With PjBL, students are expected to develop critical thinking skills.

4. CONCLUSION

The findings of this study support the idea that the science learning outcomes of fifth-grade students at SDN Tomang 03 were carried out well using the PjBL model. The results of the hypothesis test were calculated using a 2-way ANOVA with Fcount = -0.27 and Ftable = 4.139, with db numerator = 1, db denominator = 36, and significance level = 0.05. The comparison between the Fcount obtained and Ftable, the Fcount value < Ftable or -0.27 < 4.139. Thus, it can be concluded that H0 is accepted and H1 is rejected, which means there is no interaction between PjBL and digital literacy on critical thinking. This research can encourage teachers to use project-based learning more effectively in their teaching, particularly in discovering and developing students' critical thinking skills.

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