JSSH (Jurnal Sains Sosio Humaniora)
Vol. 8(1), 2024
https://online-journal.unja.ac.id/jssh
e-ISSN: **2580-2305;** p-ISSN: **2580-1244**

Implementation of Science Literacy Through Eclipse Diorama Project in Grade VI at Supriyadi Elementary School Semarang

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ARTICLE INFO

Keywords:
science literacy, project based learning, eclipse diorama, scientific project

DOI:
http://dx.doi.org/
10.22437/jssh.v8i1.33955

Received:
December 29, 2023

Reviewed:
May 27, 2024

Accepted:
June 8, 2023

ABSTRACT

This study explores the implementation of an eclipse diorama project as a strategy to enhance students' scientific literacy. In the Contact phase, the teacher introduces the phenomenon of solar eclipses, sparking students' curiosity. In the Curiosity phase, students are given the opportunity to delve deeper into the topic, developing their inquiry skills. The Elaboration phase involves students in diorama projects, allowing them to apply their knowledge in a practical context. A descriptive qualitative research method is used to observe these stages. It was found that through this approach, students' motivation increased, their inquiry skills were enhanced, and their understanding of scientific concepts deepened in three steps. Thus, the implementation of the eclipse diorama project provides holistic understanding and a profound learning experience for students, preparing them to tackle scientific challenges and the demands of the 21st century.

1. Introduction

In 2023, the results of the Programme for International Student Assessment (PISA) research stated that Indonesia ranked 68th in literacy and numeracy (PISA, 2023). This data indicates that Indonesia has improved by 5-6 ranks compared to the previous 2018. Despite this improvement, Nadiem Makarim, the Minister of Education and Culture of Indonesia, also revealed that the average science literacy in Indonesia has decreased by 12 percent, while in some major countries such as Germany, Iceland, the Netherlands, Norway, and Poland, there has been a drastic decline of up to 18 percent (Media, 2023). Klaus Becker attributed this decline to the impact of the COVID-19 pandemic, which has made students passive in learning activities and reduced their interest in scientific skills (Klaus Becker, 2023). This is a challenge not only faced by Indonesia but also by all countries striving to improve scientific literacy in

their education systems.

To response the global decline in scientific literacy, the state of Georgia has undertaken comprehensive educational reforms focusing on teaching practices through a scientific literacy approach, which has subsequently been adopted by 32 states in America (Jabari Gibbs, 2023). In addition to Georgia, Ireland is also striving to reform its curriculum by emphasizing a deep understanding of scientific concepts in its teaching. As Nicola Broderick expressed, if the implementation of this new curriculum becomes a new vision in Irish elementary schools, so too does the role of educators as the central focus of scientific literacy application (Broderick, 2023).

In Indonesia, the term 'scientific literacy' is well known among the public; however, understanding and awareness of the concept are still limited. Many consider scientific literacy to be merely about reading and writing activities, whereas it encompasses more than just that. Scientific literacy is defined as the process of scientific understanding, enabling individuals to make informed decisions in various aspects of life. Scientific literacy usually includes understanding scientific methods, the ability to interpret data and graphs, and awareness of complex environmental and health issues. This statement is also echoed by Herbert Walberg in John L. Rudolph's research, stating that scientific literacy is the ability to understand, evaluate, and engage with scientific information, such as critically thinking about scientific issues and making decisions based on scientific evidence (Rudolph, 2024).

To address the challenge of declining scientific literacy, the Ministry of Education and Culture is also making efforts by urging educators to continuously encourage students to think critically and analytically in every science learning activity. Additionally, integrating practical activities or simple experiments in the classroom can help students understand scientific concepts through direct experience and develop observational skills. The research conducted by Herlanti et al. supports this by revealing that learning with a scientific approach consisting of observation, questioning, and experimentation can increase students' scientific literacy by 57 percent (Herlanti et al., 2019). The success of such learning is closely related to the role of teachers as innovators, facilitators, and motivators, expected to create a conducive and supportive learning environment.

One concrete example of teachers' efforts to improve scientific literacy in schools is by implementing project-based learning and direct experiments. Supriyadi Elementary School in Semarang, as one of the favorite private schools in the city, always emphasizes academic skills, especially in the field of science. The school is known for its innovative learning approach, focusing on project-based and hands-on experiments to enhance students' scientific literacy from an early age. Moreover, Supriyadi Elementary School has modern and well-equipped facilities, as well as competent and dedicated teachers. With this comprehensive approach, Supriyadi Elementary School is committed to producing a generation that is not only academically excellent but also possesses critical and creative thinking skills needed in the era of technology and information.

One fascinating scientific activity for researchers is the implementation of an eclipse diorama project conducted by the VI A class teacher at Supriyadi Elementary School in Semarang. In this activity, the teacher invites students to understand the concept of lunar or solar eclipses through the creation of a diorama representing the event. This diorama can include various elements such as models of the moon, sun, and earth, as well as adjusted lighting to simulate the eclipse. The process of creating an eclipse diorama allows students to visually

see how an eclipse occurs and how the relative positions of the moon, sun, and earth affect the event. Additionally, students can learn about the types of eclipses, the factors influencing their occurrence, and their impact on life on Earth. Therefore, in this study, researchers will examine the process of implementing the eclipse diorama project as an effort by the teacher to improve scientific literacy in the VI A class students.

2. Literature Review

2.1 Scientific Literacy Concept

Scientific literacy is a concept of paramount importance in modern society, especially in an era where technology and science are rapidly advancing. The ability to understand, interpret, and utilize scientific information in everyday life is becoming increasingly crucial. The concept of scientific literacy encompasses several key aspects, including understanding scientific methods, knowledge of scientific concepts, and the ability to critically analyze scientific information. In Rudolph's view, scientific literacy is not just about mastering scientific facts but also about developing critical thinking and analytical skills that can be applied in various life contexts (Rudolph, 2024).

The development of scientific literacy can be achieved through habitual activities focusing on critical and analytical thinking skills, such as the application of simple experiments. Gu, in research conducted by Maghfiroh, explains that scientific literacy has five important indicators. These include understanding scientific concepts, adopting a scientific perspective, the nature of scientific inquiry, rejection of misconceptions as a scientific attitude, and involvement in public scientific affairs (Maghfiroh et al., 2023).

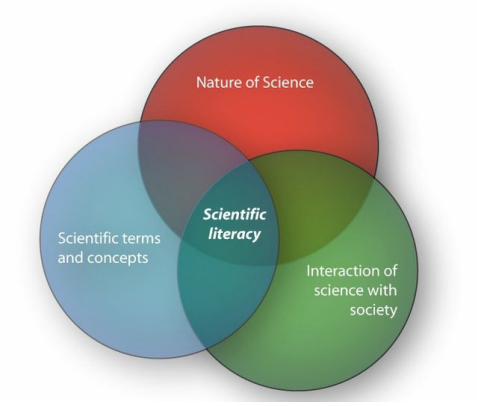

Figure 1. Scintific Literacy Concept

To achieve these indicators, Dr. Harlen emphasizes three stages of learning in the scientific literacy approach that need to be applied. These stages include the Contact Stage, the Curiosity Stage, and the Elaboration Stage (Wynne Harlen, 2005). By implementing this approach, students can develop a deep understanding of science and the skills needed to become literate in the world of science. The Contact Stage refers to the phase where students are introduced to the concepts or phenomena to be studied, often through demonstrations or presentations by the teacher. The Curiosity Stage encourages students to cultivate curiosity and ask questions that lead to deeper understanding (Medicine et al., 2016). Meanwhile, the Elaboration Stage involves more in-depth activities, such as experiments or research projects, which allow students to apply the concepts they have learned in practical contexts and develop their analytical skills. Thus, the scientific literacy approach proposed by Dr. Harlen provides a solid

foundation for the development of holistic and in-depth understanding and skills in science for students.

2.2 Relation Between Project-Based Learning and Scientific Literacy

Project-Based Learning (PjBL) has a strong connection with scientific literacy, which is the ability to understand, analyze, and apply scientific concepts in everyday life (Quinapallo-Quintana & Baldeón-Zambrano, 2024). Scientific literacy is a crucial component of 21st-century education, as it helps students develop a deep understanding of the world around them and the ability to make decisions based on scientific evidence. PjBL, with its hands-on and inquiry-based approach, is particularly well-suited to support the development of scientific literacy among students.

One of the main ways PjBL enhances scientific literacy is through the active involvement of students in the process of scientific inquiry. According to research by Roosyanti & Suryarini, PjBL allows students to engage in various scientific activities, such as formulating research questions, designing and conducting experiments, collecting and analyzing data, and presenting their findings (Roosyanti & Suryarini, 2024). This process not only strengthens students' understanding of scientific concepts but also teaches critical thinking and problem-solving skills essential for scientific literacy. Furthermore, PjBL can increase students' motivation and interest in science. Projects that are relevant to real life and aligned with students' interests make science learning more engaging and meaningful.

According to (Wijnia et al., 2024), involvement in compelling projects can boost students' interest in science and encourage them to pursue careers in STEM (Science, Technology, Engineering, and Mathematics). This increased motivation plays a crucial role in the development of scientific literacy, as motivated students are more likely to strive to understand and apply scientific concepts. However, the success of PjBL in enhancing scientific literacy also depends on the support and guidance from teachers. Teachers need to have a strong understanding of scientific concepts and pedagogical skills to facilitate project-based learning effectively.

3. Research Methodology

3.1 Research Design

This type of research is descriptive qualitative research involving data collection through observation and interviews, which are then analyzed using Miles and Huberman's (1994) technique. This technique involves three main stages: data reduction, data display, and conclusion drawing/verification. In the data reduction stage, information obtained from observation and interviews is filtered to select relevant and important data (Miles & Huberman, 1994). Subsequently, this data is presented in a more structured form for better understanding. The final stage is conclusion drawing and verification, where the researcher interprets the presented data and ensures that the conclusions drawn are consistent with the available evidence.

3.2 Participants

The subjects of this research are the teachers and students of class VI A at SD Supriyadi Semarang who implement the Eclipse Diorama project. Data in the study were obtained based on direct observation results and also interviews with the relevant teachers, supported by field notes and documentation. Direct observation allows the researcher to see in detail how the

diorama project is implemented in the classroom, while interviews with teachers provide deep insights into their experiences and views regarding the project implementation. Field notes record various events and interactions that occur during observation, while documentation in the form of photos and videos is used to strengthen and complement the data obtained.

4. Findings and Discussion

Figure 2. Supriyadi Elementary School building in Semarang and student achievements.

SD Supriyadi Semarang is a school under the auspices of the Al-Falah Semarang Islamic Education Foundation, known for the outstanding achievements of its students. Achievements include being finalists in national science competitions, winning first place in the city-level National Science Olympiad (OSN), and ranking first in the Natural Sciences subject examination. This indicates that behind these achievements are the efforts of teachers to foster interest and enhance the abilities of students in the field of science, one of which is by creating creative and innovative media projects, as often done by Mr. Yuuki Chleo Pratama Setiyono, the VI A class teacher at SD Supriyadi Semarang. He expressed that creating these creative projects is a way to stimulate students' problem-solving abilities. This statement is supported by Jean Piaget in his book titled "Intellectual Evolution from Adolescence to Adulthood," which explains that children aged 11 and above have the ability to understand hypothetical concepts, make long-term plans, and use scientific thinking to solve problems (Piaget, 1999).

As a dedicated teacher, Mr. Yuuki revealed that various projects have been undertaken to enhance students' literacy. Among them are: (1) Establishment of reading corners, speech and poetry training to develop reading and writing literacy skills; (2) Organizing activities to sing regional songs to enrich cultural literacy, and (3) Creating Canva media to enhance students' digital literacy. Furthermore, the newest project to be implemented is the creation of an eclipse diorama in teaching solar system material, which is expected to support the improvement of students' scientific literacy. According to Mr. Yuuki, this project aims not only to train cooperation skills but also to help students understand the process of eclipses, including the relative positions of the sun, earth, and moon. In addition, students are also encouraged to actively participate in every stage of making and observing the project.

> *"So, this project not only involves group work, but also requires them to observe the results that have been made,"* said the VI A class teacher.

To implement science literacy-based learning, the book "Science Literacy: Concepts, Contexts, and Consequences" explains that there are three stages that need to be done: (1) Contact Phase, which is the initial step to introduce scientific concepts and information to foster curiosity; (2) Curiosity Phase, individuals begin to study scientific principles in more depth; and (3) Elaboration Phase, which is the stage of applying knowledge concretely by using

individual understanding to solve problems, make decisions, and innovate (Medicine et al., 2016). These stages are in line with the approach applied by Mr. Yuuki in integrating science literacy concepts into the learning process.

4.1 Contact Phase

To start this project, Mr. Yuuki first posed a question referring to the solar eclipse event that occurred in Indonesia on April 8, 2024. He introduced the topic to the students and challenged them to think deeper. Afterwards, students were asked to form small groups and share stories about their experiences watching the solar eclipse. This strategy was chosen so that students wouldn't just passively receive information but actively engage in their learning process. By sharing their stories and experiences about the solar eclipse, it was hoped that students could connect theoretical knowledge with practical experience and stimulate their curiosity to understand the natural phenomenon more deeply. This reason was directly expressed by Mr. Yuuki,

> *"I prefer to engage students in discussions based on real phenomena because it encourages them to ask why such events occur."*

Figure 3. Mr. Yuuki explains the phenomenon of a solar eclipse in Indonesia to the students.

The contact phase in the context of science literacy is the initial step in the learning process where students are first exposed to the concepts or phenomena they will study. In the book "Culturally Relevant Schooling in Science for Indigenous Learners Worldwide: Stressing the All in Science Literacy for All" by Bybee and Powell, the importance of this contact phase in developing students' interest and motivation in science is emphasized (Abrams et al., 2014). This phase can involve introducing concepts through stories, videos, experiments, or direct experiences that capture students' attention and relate them to everyday life contexts (Ying-Chih Chen & Michelle Jordan, 2023). In the contact phase, the main goal is to trigger students' curiosity and prepare them to explore concepts further.

Mr. Yuuki's strategy in initiating this project is very much in line with the contextual learning theory. This theory emphasizes that learning is more effective when students can relate subject matter to their real-life contexts. Contextual learning helps students understand the material better because they can see the relevance and practical application of what they are learning (Puji et al., 2024). In this case, Mr. Yuuki uses the recent solar eclipse phenomenon as a context to start the learning process. By engaging students in discussion and sharing experiences about the solar eclipse, Mr. Yuuki utilizes students' real experiences to explain scientific concepts. This aligns with the principles of contextual learning, which include relation, experience, and application.

4.2 Curiosity Phase

In the next meeting, after completing the initial stage, Mr. Yuuki gives students the opportunity to further explore the introduced topic. This stage is known as the curiosity phase in science literacy, where students are encouraged to develop their curiosity and investigative skills. The curiosity phase is an important part of the science learning process because it allows students to delve deeper into topics of interest, thus expanding their knowledge independently (Syofyan & Trisia Lusiana Amir, 2019).

During this stage, students are presented with various questions and challenges that require further exploration. Examples of these questions include: (1) What causes the phenomenon of an eclipse?; (2) What are the positions of the sun, earth, and moon during an eclipse?; and (3) What are the impacts of the eclipse event? To answer these questions, they not only learn from what is taught in class but also actively seek additional information from various sources such as books and YouTube at home. This approach aims to cultivate independent learners with high critical thinking skills and teaches them not only to passively accept information but also to become active knowledge seekers.

> *"For their source search, I give them freedom to choose from any source, and they are allowed to continue it at home, but I also recommend, for example, which YouTube accounts are suitable but also interesting,"* Mr. Yuuki said.

According to Vygotsky, this process also involves the social dimension in the constructivist process of the Zone of Proximal Development (ZPD) and scaffolding. In the context of the curiosity phase, Raslan in his research revealed that teachers act as facilitators who provide guidance and support (scaffolding) to help students overcome challenges and achieve deeper understanding (Raslan, 2024). This is implemented by Mr. Yuuki, who provides step-by-step guidance on how to find reliable sources. Thus, students learn to seek valid information.


Figure 4. The students are discussing with each other and searching for learning resources.

Mr. Yuuki implements the curiosity phase in his class through several strategies, one of which is group discussion activities. Small group discussions allow students to exchange ideas and perspectives, as well as learn from their peers. For example, in a discussion about eclipses, students can share information they have found from various sources, discuss their findings, and build a collective understanding of the topic. Upon closer examination, the curiosity phase has several positive impacts on students' development, including increasing motivation to learn and developing research skills. However, this phase also presents challenges, such as the high likelihood of encountering information from unreliable sources. Therefore, Mr. Yuuki needs to provide guidance on time management and set realistic deadlines. Some students may require more support to go through this phase, especially if they are not accustomed to independent

learning methods.

4.3 Elaboration Phase

After completing the curiosity stage, students then enter the elaboration stage. This stage serves as an opportunity for students to develop and integrate the knowledge they have previously acquired. Beyond just understanding concepts superficially, the elaboration stage invites students to deepen their understanding and apply it in more complex contexts. In Mr. Yuuki's instruction, the elaboration stage is implemented through project activities and presentations. Students are tasked with creating a diorama of an eclipse using materials they have prepared themselves in the previous days. In this project, they are expected not only to explain what they have learned but also to demonstrate their ability to analyze and synthesize information. Students must show the relative positions of the sun, earth, and moon during an eclipse. Additionally, they can produce a written report for their presentation that outlines the scientific explanation of the eclipse, its impacts, and how the phenomenon can be observed.

In guiding the elaboration stage, Mr. Yuuki provides clear guidelines and assessment rubrics to ensure that students understand the expectations and can direct their efforts effectively. Collaboration among students is also enhanced at this stage, allowing them to learn from each other and strengthen their understanding through group discussions. The elaboration stage plays a crucial role in developing students' critical and analytical thinking skills. By giving students the opportunity to develop and apply their knowledge in a deeper context, they can enhance their understanding of scientific concepts and hone their skills in analyzing information.

The analysis of the elaboration stage can be understood through the lens of science literacy theory, which emphasizes the importance of developing students' critical and analytical thinking skills when confronting scientific concepts. By being given the chance to develop and apply their knowledge in a more in-depth context, students not only improve their understanding of the subject matter but also sharpen their abilities to analyze information and present it effectively. Thus, the elaboration stage becomes an integral part of the learning process aimed at improving students' science literacy.

Figure 5. The students are grouped to create an Eclipse Diorama project based on information gathered from previous sources.

The impact of these three stages on students is significant. First, the contact stage helps increase motivation and readiness to learn, creating a conducive environment for further exploration. This stage serves as an initial bridge that connects students with the material they will study, introducing the topic in an engaging and relevant manner. The result of this stage is increased student interest and enthusiasm, which is crucial for encouraging deeper engagement

in the subsequent stages. High motivation is an important indicator in science literacy, as motivated students are more likely to actively seek a deeper and broader understanding of scientific concepts.

Second, the curiosity stage enhances inquiry skills and critical thinking abilities, as students are encouraged to ask questions and seek answers independently. In this stage, students are encouraged to develop their curiosity through investigation and exploration. They learn to formulate relevant and significant research questions, conduct initial experiments, and seek information from various sources. The inquiry and critical thinking skills developed at this stage are vital for science literacy because they help students build the ability to evaluate information, make hypotheses, and draw conclusions based on evidence. These abilities are key components of science literacy, enabling students to effectively participate in scientific discussions and make decisions based on scientific understanding (Herlanti et al., 2019).

Third, the elaboration stage deepens conceptual understanding and hones analytical skills, preparing students to apply their knowledge in real-world contexts and present their findings confidently. In this stage, students are given the opportunity to expand and deepen their understanding of the topic studied through practical applications and in-depth analysis. They learn how to analyze data, identify patterns, and construct logical and structured arguments. This stage is crucial for science literacy because it allows students to integrate theory with practice, develop deep analytical skills, and prepare them to present their findings clearly and convincingly (Romli et al., 2024). The ability to apply scientific concepts in real situations and communicate effectively are essential aspects of science literacy, ensuring that students not only understand the material but also can use it practically. This is similar to what was expressed by one of the students in class VI A,

> *"We feel satisfied with what we have done. Rather than just learning through theory, we prefer to practice it directly."*

The integration of these three stages in PjBL creates a holistic and comprehensive learning experience that not only enhances science literacy but also develops important 21st-century skills such as teamwork, communication, and problem-solving. PjBL encourages students to work in teams, share ideas, and collaborate to achieve common goals (Crawford et al., 2024). The ability to work together and communicate effectively is essential in science literacy because science often involves collaboration across various disciplines and individuals. Additionally, problem-solving is at the core of the scientific process, and PjBL provides many opportunities for students to face real challenges, design solutions, and test their hypotheses in relevant contexts.

Thus, PjBL and its stages provide a robust framework for effective and meaningful learning, preparing students to face future challenges with relevant knowledge and skills. Through increased motivation in the contact stage, the development of inquiry and critical thinking skills in the curiosity stage, and the deepening of understanding and analytical skills in the elaboration stage, students gain a comprehensive learning experience. This experience not only strengthens their science literacy but also prepares them to become critical thinkers, effective problem solvers, and competent communicators, all of which are crucial skills for success in the modern world. Overall, the implementation of PjBL with clear guidance and support from teachers like Mr. Yuuki can result in profound positive impacts on students' academic and personal development, shaping them into individuals who are better prepared to face future challenges and opportunities with strong knowledge and skills in science and beyond.

5. Conclusion

Through three important stages—Contact, Curiosity, and Elaboration—Mr. Yuuki can be considered successful in implementing a diorama project to enhance students' science literacy. In the Contact Phase, he introduces recent real-world phenomena in Indonesia such as solar eclipses, sparking students' curiosity and aligning with contextual learning principles to enhance relevance. Next, in the Curiosity Phase, students independently explore the topic, refining their inquiry and critical thinking skills under Mr. Yuuki's guidance. In the final stage, the Elaboration Phase, students integrate knowledge through hands-on diorama projects, deepening their understanding and analytical abilities while fostering collaboration. This Project-Based Learning offers a comprehensive experience that not only advances scientific literacy but also cultivates crucial 21st-century skills, preparing students for success in a rapidly changing world.

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