# Improving Science Literacy and Student Learning Outcomes Through the Ethnoscience-Based PJBL Model in Elementary Schools

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**Abstract**

*Science literacy is one of the basic skills to compete in an increasingly competitive life. However, Indonesian students still have a low level of science literacy. This study aims to determine the differences in science literacy and cognitive learning outcomes of students in the experimental and control classes and to determine students' responses to the ethnoscience-based PjBL model in learning. This quasi-experimental study used a non-equivalent control group design. The research sample was students of SDN Karduluk 2 Sumenep. Data collection was carried out using test and non-test methods. The instruments used were science literacy and cognitive learning outcomes tests and response questionnaires as non-test instruments. Data analysis was carried out using descriptive and inferential analysis. The results showed significant differences in science literacy and cognitive learning outcomes between students in the experimental and control classes. The ethnoscience-based PjBL model received an excellent response. This study concludes that the ethnoscience-based PjBL model can improve students' science literacy and cognitive learning outcomes. This study contributes to chemistry learning by improving science literacy and learning outcomes through the ethnoscience-based PjBL model.*

**Keywords:** *Science Literacy, Pjbl Model, Ethnoscience.*

## INTRODUCTION

Education has an important role in equipping students to face future challenges, including the challenges of 21st century learning (Ichsan et al., 2020). 21st century learning which is closely related to the industrial revolution 4.0 has had a tremendous impact on education. Education not only teaches knowledge, but also ensures that students have various abilities (Yunianto et al., 2020). One of the abilities that students really need today is scientific literacy (Muliastrini, 2020). Scientific literacy is one of the basic skills for compete in an increasingly competitive life (Kahler et al., 2020). According to the Program for International Student Assessment (PISA), scientific literacy is the ability to be involved in problems related to science, use scientific knowledge, recognize problems, and develop conclusions based on existing facts (OECD, 2019). Scientific literacy is not only limited to understanding science, but also understanding scientific processes and information in everyday life up to the decision-making stage (Haerani et al., 2020). Therefore, scientific literacy in learning must be improved so that students not only understand it as a concept, but also understand and solve problems for modern society related to science and technology by applying science knowledge (Ihsan & Jannah, 2021; Khery et al., 2020). However, Indonesian students still have a low level of scientific literacy, as in the latest PISA results in 2018. Of 78 countries, Indonesia is in 70th position in the scientific literacy category (Kahler et al., 2020; Sadoglu, 2018).

The importance of increasing scientific literacy is still not in line with current learning. Scientific literacy focuses on the meaningful use of scientific concepts to build students' knowledge (Ihsan & Jannah, 2021; Jufrida et al., 2019; Khery et al., 2020). However, Dewi et al. (2021) stated that students are still not optimal in processing material and information from teachers when learning chemistry in class and implementing it in everyday life. Teaching aids and learning questions in schools are also not based on scientific literacy, so students are not used to working on questions based on scientific literacy (Fuadi et al., 2020). Low scientific literacy indicates low cognitive learning achievement because it has a positive relationship (Kulsum et al., 2020). Learning outcomes are a reflection of how well the learning process has taken place. If students' learning achievements do not meet the minimum criteria, then the learning is not optimal (Asy'syakurni et al., 2021; Wahyuni & Yusmaita, 2020). This low cognitive learning achievement is caused by students' difficulties in

Volume. 10 Nomor. 1 Februari 2025
p-ISSN: 2548-5555, e-ISSN: 2656-6745

understanding abstract concepts and not being able to apply these theories in real life (Pitnelly et al., 2021; Sutrisna, 2021).

One solution to improve scientific literacy and cognitive learning outcomes is to use appropriate and innovative learning models. The Project Based Learning (PjBL) model can provide direct, student-centered experience. This model facilitates students to acquire knowledge and skills through involvement in project development and implementation. Projects with complex tasks will encourage students to design, solve problems, make decisions, and display products (Kulsum et al., 2020; Nugraha, 2022). Irfan (2019) added that in the PjBL model, students can convey and realize their ideas, thus providing a positive stimulus in discovering new concepts. Apart from learning models, approaches also influence the quality of learning. One scientific approach that can improve scientific literacy and science learning outcomes is ethnoscience (Wiradintana, 2018). Ethnoscience is knowledge that comes from culture and is part of society that has the concept of science (Suswati, 2021). We can find this knowledge in language, customs, traditional food, moral values, habits, rules and technological prohibitions created in a scientifically informed society (Nuralita, 2020). In the field of education, ethnoscience learning can be a breakthrough that combines culture with science in the learning process. The application of ethnoscience-based learning will strengthen students' understanding of scientific concepts because they study local culture and wisdom to reveal scientific knowledge within them (Lathifah et al., 2019). Apart from that, students can apply scientific concepts and connect material with community knowledge so that scientific literacy will also increase (Ulfah et al., 2020; Zannatunna'imah et al., 2021).

Several studies have shown the effectiveness of implementing the PjBL model in learning. Nuraini and Waluyo (2021) concluded that student learning outcomes can be improved by implementing the PjBL model. This is in line with Hamidah et al. (2021) which shows that there are significant differences in knowledge learning outcomes by applying the PjBL model. Anggreni et al. (2020) and Hasbie et al. (2018) shows that students' scientific literacy is influenced by the PjBL model. Other research also shows the effectiveness of ethnoscience-based learning, such as Sholahuddin et al. (2021) and Wibowo and Ariyatun (2020). Wulandari et al. (2018) concluded that ethnoscience-based learning can improve scientific literacy skills. Nuralita (2020) and Winarti et al. (2018) shows that ethnoscience-based learning has a significant effect on cognitive learning outcomes. One of the science materials with abstract concepts in the form of memorization is the colloid system. This colloid system is very close in everyday life. If studied in more depth, colloids will provide many benefits and broad applications in various fields in everyday life (Falah et al., 2018; Hau et al., 2021). Students will more easily understand colloids and obtain complete concepts through active, interesting and student-centered learning (Mirnawati et al., 2021).

Based on the previous description, previous research has examined the use of the PjBL model or ethnoscience-based learning on scientific literacy or learning outcomes. However, research on the use of the ethnoscience-based PjBL model to improve scientific literacy skills and cognitive learning achievements has not been found. Therefore, this research aims to determine the differences in scientific literacy and cognitive learning achievements of students in the experimental and control classes and to determine students' responses to the ethnoscience-based PjBL model in learning.

## METHOD

This quasi-experimental research uses a non-equivalent control group design. In this research, the experimental group used the ethnoscience-based PjBL model and the control group used the discovery learning model. The population in this study were class V students at SDN Karduluk 2. Sampling was carried out using purposive sampling by selecting two sample classes, namely class Va as experimental class and class Vb as the control class. The number of students in each class is 33 people. Data collection was carried out using test and non-test methods. The test instruments used were a scientific literacy test with eight essay questions

Volume. 10 Nomor. 1 Februari 2025
p-ISSN: 2548-5555, e-ISSN: 2656-6745

and a cognitive learning test with ten multiple choice questions. The test questions have met the validity, reliability, level of difficulty and differentiability tests. The non-test instrument is a response questionnaire with 10 statement items. The data in this research were analyzed using descriptive and inferential analysis. Descriptive analysis is used to analyze scientific literacy, cognitive learning achievements, and student responses. Learning outcomes in the form of pre-test and post-test data are processed into N-gain (Wibowo & Ariyatun, 2020) to determine the extent to which students experience increased scientific literacy and cognitive learning achievements. The overall normalized N-gain obtained is categorized as in Table 1

Table 1. Normalized N-gain categories

| Gain index | Category |
|---|---|
| $g \leq 0,3$ | Low |
| $0,3 < g \leq 0,7$ | Currently |
| $g > 0,7$ | High |

Data about student responses to the application of the model PjBL ethnoscience-based measured by response questionnaire. Student response scores are explained using categories in Table 2.

Table 2. Student Response Categories

| Score | Category |
|---|---|
| 42 – 50 | Very good |
| 34 – 41 | Good |
| 26 – 33 | Enough |
| 18 – 25 | Not enough |
| 10 – 17 | Very less |

Inferential analysis which includes normality test, homogeneity test, and t-test is used to analyze differences between scientific literacy and cognitive learning outcomes. If t-count > t-table, then there is a significant difference between the average scores of students in the experimental class and the control class.

## RESULTS AND DISCUSSION

N-gain data showing the increase in scientific literacy scores of experimental and control class students is in Table 3.

Table 3. N-gain for scientific literacy data

| Class | Results | Rat rat | N-gain | Category |
|---|---|---|---|---|
| Experiment | Pre-test | 28,79 | 0,74 | High |
| | Post-test | 80,18 | | |
| Control | Pre-test | 29,55 | 0,62 | Currently |
| | Post-test | 71,34 | | |

Independent t test for normality and homogeneity of experimental and control class scientific literacy data is in Table 4.

Table 4. Independent T Test of Scientific Literacy Data

| Data | Class | db | $\bar{X}$ | $SD^2$ | t-count | table 5% | Conclusion |
|---|---|---|---|---|---|---|---|
| *Pre-test* | Experiment | 64 | 28,79 | 251,05 | 0,19 | 2,00 | No difference |
| | control | 64 | 29,55 | 246,71 | | | |
| *Post-test* | Experiment | 64 | 80,18 | 126,99 | 2,85 | 2,00 | Significantly different |
| | control | 64 | 71,34 | 180,94 | | | |

Table 3 shows that the experimental class that implemented the ethnoscience-based PjBL model had a more significant increase in scientific literacy scores than the control class. Table 4 shows significant differences in scientific literacy in the experimental and control classes. Based on these data, it can be concluded that learning using the ethnoscience-based PjBL model can increase scientific literacy. The different treatments used in the control and experimental classes resulted in different increases in students' scientific literacy. Through project development and implementation, the PjBL model in the experimental class encourages students to actively participate in the learning process. By engaging in difficult tasks, students will learn new things. Anggreni et al. (2020) also shows that the use of the PjBL model increases students' scientific literacy because their involvement will train them to identify scientific issues, explain scientific phenomena, and use scientific evidence. The integration of ethnoscience in experimental classes also influences scientific literacy. These results are in line with Ningsih et al. (2018) which shows that the use of the PjBL model and the integration of traditional food ethnoscience significantly increases scientific literacy. Students can build abstract colloid knowledge into reality and make connections between colloid concepts to provide a meaningful learning experience. The research results showed that both classes experienced the highest percentage of achievement in indicator 1 compared to other indicators. This finding is in line with Sholahuddin et al. (2021) which shows that the indicator of remembering and applying appropriate scientific knowledge in both classes has the highest achievement compared to other scientific literacy indicators. Indicator 6 obtained the lowest percentage compared to other indicators. This means that students still have difficulty describing and evaluating the various methods used by scientists to ensure the validity and objectivity of data and generalize explanations. These results are in line with Sari et al. (2017) which shows that this indicator has the lowest percentage of indicator achievement compared to other indicators in the competency to evaluate and design scientific research. N-gain data showing an increase in cognitive learning outcomes for experimental and control class students is presented in Table 5.

Table 5. N-gain for Cognitive Learning Outcome Data

| Class | Data | Rat rat | N-gain | Category |
|---|---|---|---|---|
| Experiment | *Pre-test* | 38,79 | 0,82 | High |
| | *Post-test* | 88,18 | | |
| Control | *Pre-test* | 39,09 | 0,73 | High |
| | *Post-test* | 82,12 | | |

The independent t test for normality and homogeneity of cognitive learning outcomes data for the experimental and control classes is presented in Table 6.

Table 6. Independent t test of Cognitive Learning Results Data

| Data | Class | db | $\bar{X}$ | $SD^2$ | t-count | 5% t-table | Conclusion |
|---|---|---|---|---|---|---|---|
| *Pre-test* | Experiment | 64 | 38,79 | 217,23 | 0,08 | 2,00 | No difference |
| | control | 64 | 39,09 | 189,77 | | | |
| *Post-test* | Experiment | 64 | 88,18 | 102,84 | 2,34 | 2,00 | Significantly different |
| | control | 64 | 82,12 | 110,98 | | | |

Table 5 shows that the experimental class that implemented the ethnoscience-based PjBL model experienced a more significant increase in cognitive learning achievements compared to the control class. Table 6 shows that cognitive learning achievements in the experimental class

Volume. 10 Nomor. 1 Februari 2025
*p-ISSN:* 2548-5555, *e-ISSN:* 2656-6745

and control class are significantly different. Based on these data, it can be concluded that learning using the ethnoscience-based PjBL model can improve cognitive learning outcomes. The results of this research are in line with the research of Mukti et al. (2020) which shows that the average learning achievement in classes that apply the PjBL model is higher than in classes that apply discovery learning. Muliaman and Mellyzar's (2020) research also shows that learning outcomes from using the PjBL model have increased significantly and obtained a higher average increase compared to the control class. Another research conducted by Wulandari et al. (2018) also shows that ethnoscience-based learning increases student learning outcomes.

In the PjBL model, students construct their knowledge through involvement in completing projects that are close to everyday life. Muliaman and Mellyzar (2020) stated that using the PjBL model will encourage students to connect concepts or subject matter in everyday life, increase student activity during the learning process, increase motivation, and develop teamwork so that students' cognitive learning outcomes also increase. The integration of ethnoscience in experimental classes also influences cognitive learning outcomes. Through ethnoscience-based projects, students' understanding will increase because linking the knowledge in the project of making traditional food with scientific knowledge can strengthen students' understanding, so that cognitive learning outcomes will also increase. The research results showed that the experimental class had a higher percentage of indicator achievements than the control class.

Student response questionnaires are given at the end of the lesson. This questionnaire is to determine the extent of students' interest and acceptance of the application of the ethnoscience-based PjBL model in the experimental class and the discovery learning model in the control class. The average responses of students in the experimental and control classes are presented in Table 7.

Table 7. Average Student Responses

| Class | Rat rat | Category |
|---|---|---|
| Experiment | 43,27 | Very good |
| Control | 39,94 | Good |

Student responses were classified into positive responses for students who gave strongly agree and agree answers, neutral responses for students who gave uncertain answers, and negative responses for students who gave disagree and strongly disagree answers. Table 7 shows that experimental class students responded to learning using the ethnoscience-based PjBL model in the very good category. Meanwhile, control class students responded in the good category. The positive response of experimental class students to the use of the ethnoscience-based PjBL model had a higher percentage than the control class. The very good student response to learning using the ethnoscience-based PjBL model is in line with research by Ardianti and Raida (2022) which states that the ethnoscience-based PjBL model has a positive response with an average score of 89.60% in the very good category. Learning using the PjBL model can encourage students to actively participate in project activities (Anggreni et al., 2020). Using the PjBL model can make students active and creative in completing projects with their groups (Birdman et al., 2022; Lestari & Juanda, 2019). The use of ethnoscience is also a breakthrough that combines culture with science in the learning process so that students are interested in learning because it is close to life (Mirnawati et al., 2021; Nuralita, 2020). Apart from that, learning that uses the ethnoscience-based PjBL model by highlighting local culture and wisdom makes learning more meaningful and can broaden students' horizons so that the learning process becomes interesting and fun (Ardianti & Raida, 2022; Nuralita, 2020). From these results, students are enthusiastic about learning using the ethnoscience-based PjBL model, so it is hoped that teachers can use it in other materials.

## CONCLUSION

The project-based learning model allows students to build their knowledge through completing projects. Using ethnoscience also allows students to deepen their knowledge, apply scientific concepts, connect culture and societal knowledge with science, and increase their understanding of scientific concepts. Based on the research results, scientific literacy and student cognitive learning outcomes differ significantly between the experimental class which applies the ethnoscience-based PjBL model and the control class which applies the discovery learning model. This research also found that the ethnoscience-based PjBL model received a very good response from students. This research suggests that educational practitioners use the ethnoscience-based PjBL model in learning to improve students' scientific literacy and cognitive learning outcomes so that it has a good impact on the learning process, especially in science learning. It is hoped that future research can apply the ethnoscience-based PjBL model to other materials

## ACKNOWLEDGEMENT

Accept love to the supervisor for helping to complete the final assignment.

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