Jurnal Ilmiah Sekolah Dasar
Volume 7, Number 4, 2023 pp. 590-598
P-ISSN: 2579-3276 E-ISSN: 2549-6174
Open Access: https://doi.org/10.23887/jisd.v7i4.62080

Improving Scientific Literacy of Elementary School Students through Problem-Based Learning Model with Balinese Local Wisdom

Ni Luh Dina Restiani[1*], I Gede Margunayasa[2], Made Vina Arie Paramita[3]

[1,2,3] Pendidikan Guru Sekolah Dasar, Universitas Pendidikan Ganesha, Singaraja, Indonesia

ARTICLE INFO

Article history:
Received May 25, 2023
Accepted October 23, 2023
Available online November 25, 2023

Kata Kunci:
Pembelajaran Berbasis Masalah, Kearifan Lokal Bali, Literasi Sains

Keywords:
Problem-based Learning, Balinese Local Wisdom, Scientific Literacy

ABSTRAK

Literasi sains siswa di sekolah dasar saat ini masih rendah. Hal ini disebabkan oleh pelaksanaan proses pembelajaran yang belum sesuai dengan tujuan pembelajaran IPA dan pelaksanaan pembelajaran masih cenderung berpusat pada guru. Siswa belum mampu menggunakan pengetahuan sains yang dimilikinya untuk memecahkan permasalahan yang berkaitan dengan kehidupan sehari-hari. Tujuan penelitian ini adalah menganalisis pengaruh model pembelajaran berbasis masalah berkearifan lokal Bali terhadap literasi sains siswa. Jenis penelitian ini adalah penelitian eksperimen semu. Populasi penelitian ini adalah siswa kelas lima sekolah dasar. Sampel penelitian dipilih menggunakan random sampling dengan jumlah sampel yaitu 55 siswa. Pengumpulan data dilakukan dengan metode tes. Instrumen yang digunakan untuk mengumpulkan data adalah tes literasi sains. Tahapan analisis data yang dilakukan yaitu deskripsi data, uji prasyarat analisis, dan uji hipotesis. Hasil penelitian yaitu terdapat perbedaan yang signifikan literasi sains siswa antara kelompok siswa yang dibelajarkan dengan model pembelajaran berbasis masalah berkearifan lokal Bali dan model pembelajaran konvensional. Literasi sains pada siswa yang belajar dengan model pembelajaran berbasis masalah berkearifan lokal Bali lebih tinggi dibandingkan siswa yang belajar dengan model pembelajaran konvensional. Implikasi penelitian ini yaitu model pembelajaran berbasis masalah berkearifan lokal Bali dapat digunakan oleh guru dalam pembelajaran untuk meningkatkan literasi sains pada siswa.

ABSTRACT

Students' scientific literacy in elementary school is currently low. This is due to the implementation of the learning process that was not in accordance with the purpose of science learning and the implementation of learning still tends to be teacher-centered. Students have not been able to use their science knowledge to solve the problems that related to daily life. The purpose of this research was to analyze the effect of problem-based learning model with Balinese local wisdom on students' scientific literacy. The type of this research was quasi-experimental research. The population of this research were fifth grade of elementary school students. The research sample was selected by using random sampling with a total sample size of 55 students. Data were collected by test method. The instrument that used to collect data was scientific literacy test. The steps of data analysis were data description, prerequisite analysis test, and hypothesis testing. The study result showed significant differences in students' scientific literacy between groups of students who were taught with problem-based learning model with Balinese local wisdom and conventional learning model. Scientific literacy in students who learn with problem-based learning model with Balinese local wisdom are higher than students who learn with conventional learning model. This research implies that problem-based learning model with Balinese local wisdom can be used by teacher in learning to improve scientific literacy in students.

1. INTRODUCTION

Science learning involves observing natural phenomena by using the scientific method to be able to solve many problems scientifically by using science concepts (Hafizah & Nurhaliza, 2021; Ismail et al., 2016). Natural phenomena become a source of knowledge that must be explored in science learning. Science

Corresponding author
*E-mail addresses: dinaarestianiii@gmail.com (Ni Luh Dina Restiani)

education is application-oriented, developing thinking skills, learning abilities, curiosity, and developing caring and responsible attitudes towards the social and natural environment (Nisa et al., 2015). One of the important objectives of science learning in elementary schools is the development of scientific literacy (Bybee, 2008; Gormally et al., 2012; Yuliati, 2017). Scientific literacy includes the act of understanding scientific knowledge and also refers to how students can use that scientific knowledge to solve the problems that come up in everyday life (Winarni et al., 2020; Wulandari & Sholihin, 2016). Scientific literacy is used to understand natural phenomena that occur in everyday life. Scientific literacy is defined as the capacity to use scientific knowledge and skills, identify questions and draw conclusions based on existing data in order to understand the universe and help to make decisions from changes that occur due to human interaction with nature. Scientific literacy is important to understand because everyone needs information that is used as a reference to think scientifically in finding solutions for problems and in making decisions. The importance of scientific literacy relates to how students are able to appreciate nature by using the science and technology that they have learned. Scientific literacy provides opportunities and limits of scientific knowledge in the context of issues that are discussed and debated (Ardianto & Rubini, 2016; Fakhriyah et al., 2017).

Scientific literacy is functionally integrative with good learning achievement. This is because in science education, it is taught as the basis for the building of students' scientific literacy to improve science learning outcomes (Cahyana et al., 2019; Margunayasa et al., 2019; Wahyu et al., 2020). However, the condition of students' scientific literacy level in Indonesian is still low (Eviani et al., 2014; Patta et al., 2021). Based on the Programme for International Student Assessment (PISA), the low scientific literacy of students in Indonesia is represented by the scores that are still lower than the international average. Indonesia achieved a score 403 from 500, so placing it at 62nd position from 70 countries in the PISA 2015 (Yansen et al., 2019). Furthermore, in PISA 2018, Indonesia achieved a score 396 from 500, so that Indonesia placed at 70th position from 78 countries (Ambarita et al., 2018). In addition, based on the results of document studies and interviews that have been conducted, it is known that 82 students in fifth grade (51%) from 7 elementary schools in Gugus VIII Buleleng District have science learning outcomes that are below the minimum completeness criteria, and have not achieved the maximum scientific literacy as indicated by not yet achieving the scientific literacy indicators. Students have not been able to connect the daily content and basic concepts to identify science problems, interpretation of data, problem solving, and making a valid conclusion. These results show that students have a limited scientific knowledge, so it is necessary to improve the quality of science learning so that it can improve the quality of students' scientific literacy (Sholahuddin et al., 2021).

The strategy, approach, and constructivism learning methods in science learning are very important to achieve a quality science learning process in the classroom (Fakhriyah et al., 2017; Wahyu et al., 2020). Problem solving skills are also very important to be implemented in science learning because the learning is based on facts or phenomena that can be explained by logic. The science learning process should be an active learning process, where the teacher acts as a learning manager who determines the learning strategy in accordance with the characteristics of students, materials, and learning environment (Pramuda et al., 2019; Sepriyani et al., 2018). However, Susanto said that one of the problems that currently occurs in the world of education is the implementation of the teaching and learning process by teachers in elementary schools which is still weak (Julianti, 2017; Margunayasa et al., 2019). Based on observations during the learning process, it is known that so far science learning is still carried out with teacher-centered learning with the lecture method which in the process is explained about the material, then given examples, and ends with giving practice questions to students. Learning is mostly a one-way process, with no interaction between teachers, students, and the learning environment. This shows that the low scientific literacy of students is caused by science learning that taught using conventional learning models that tend to only emphasize understanding based on memory, less able to build students' critical thinking skills and analysis skills.

Nowadays, there is a need to be able to introduce local wisdom in education as an effort to honor and educate students about local culture and traditions. Besides that, it is important to teach students about local wisdom as a legacy from past generations so that it is not easily replaced by foreign cultures (Pranata, 2022; Rahayu, 2022). Local wisdom-based education is education that teaches students to be close to the real situations that they face, because local wisdom-based learning is essentially sourced from community life (Pingge, 2017; Rummar, 2022). Bali, as one of the provinces in Indonesia which rich in culture and local wisdom, offers great potential in integrating local wisdom in science learning (Sudiatmika, 2013; Sudirgayasa et al., 2021). So, by using Balinese local wisdom in science learning allows students to relate science concepts to real contexts in Balinese culture. They can also see how science concepts are applied in Balinese traditions, ceremonies and daily activities. In addition, currently, science learning in fifth grade of elementary schools has been integrated with daily life activities, but has never been integrated with Balinese local wisdom. Generally, teachers use the potential of the environment only as an apperception,

not yet until a more in-depth discussion of Balinese local wisdom. If in science learning there is a continuity between the science knowledge and scientific attitudes, as well as the values of Balinese local wisdom that exist and develop in the community, then students can have more respect for nature and culture that develops in the community. So, this will also improve students' ability to use their scientific knowledge to solving problems in their daily lives. Therefore, teachers in trying to improve students' scientific literacy can integrate Balinese local wisdom in science learning by inserting Balinese local wisdom in the learning model that has been chosen (Indrawan & Mahendra, 2021; Sudiana & Sudirgayasa, 2015).

In an effort to provide a meaningful science learning so that can improve students' scientific literacy, teachers have an important contribution. One of the way that can be used is by choosing the right learning model (Aiman, 2020; Nisa et al., 2015; Novauli, 2015). In addition, teachers can integrate the various of local wisdom that exists in Bali when teaching science, namely inserting Balinese local wisdom in the learning model that has been chosen. In this case students need to be supported with learning that is connected to their daily lives, so that they can create a connection between the knowledge that they learn and the problems that happen in the environment around them. Therefore, it is necessary to have a solution to solve the problems that are related to the low level of scientific literacy in students, namely by applying an appropriate learning model, one of them is by applying a problem-based learning model with Balinese local wisdom (Fauziah et al., 2019; Widiana et al., 2020). The reason for using this learning model is that through the problem-based learning models, students can learn to remember, apply, and carry out learning process activities independently, besides that students are given the opportunity to implement their knowledge in solving a problem, and students will be more optimal in thinking through teamwork, thus making students able to improve their thinking skills continuously. The implementation of problem-based learning models with Balinese local wisdom can provide students with opportunities to have information, build concepts, and develop their thinking skills in solving problems (Irfani Lindawati & Rahayu, 2021; Masri et al., 2018). This learning model also causes more students' participation because students are guided to be actively involved in building new knowledge and solving problems through group discussions, so that it can improve students' scientific literacy (Choden & Kijkuakul, 2020; Haristy et al., 2013). Problem-based learning model with Balinese local wisdom in science learning can focus on problems by integrating local wisdom in Bali, so that it can lead students to analyze problems by using science concepts to help students find problem solving, so as to improve students' scientific literacy.

Based on the explanation above, it shows that choosing a problem-based learning model with Balinese local wisdom is very important for teachers to improve students' scientific literacy. As in previous research who conducted by previous study it is known that problem-based learning is one of the learning models that facilitates the development of students' scientific literacy because the problems presented are phenomena that occur in everyday life, so that it can improve students' scientific literacy (Fauziah et al., 2019). Through science literacy-based learning, students are able to ask or formulate questions, find answers through observation from curiosity related to phenomena in their daily lives. This is in line with other research that problem-based learning can activate students in the process of science learning activities and can improve students' way of thinking, so that students' scientific literacy will be formed by itself in the learning process (Aiman, 2020). The novelty of previous research and current research is in the learning model that is used, where in previous research only used problem-based learning models, while current research is accompanied by integrating Balinese local wisdom in problem-based learning models to improve students' scientific literacy in the material of heat and its transfers.

Ideally, the problem-based learning model with Balinese local wisdom has a positive impact on increasing students' scientific literacy. This is because the fact shows that scientific literacy has not been well achieved by students. In science learning, students need direct experience with nature accompanied by knowledge about Balinese local wisdom that related to science to make it easier to understand the lesson. So that by applying a problem-based learning model with Balinese local wisdom, students can learn through science problems related to the material of heat and its transfers that are related to Balinese local wisdom. Based on this, it is important to do a research to find out the effect of problem-based learning model with Balinese local wisdom on the scientific literacy in fifth grade of elementary school students in Gugus VIII Buleleng District in the 2022/2023 academic year. So, this study aims to analyze the differences in students' scientific literacy on the material of heat and its transfers between students who were taught with a problem-based learning model with Balinese local wisdom and conventional learning model.

2. METHOD

The type of this research is a quasi-experimental research, with non-equivalent post-test only control group design, and 2×2 factorial design. The steps in this study are the implementation of problem-based learning model with Balinese local wisdom, and then continued with giving post-test to measure the

students' scientific literacy. In the research procedure, the steps that taken in this study consist of three steps, both in the experimental and control groups, namely the research preparation, the research implementation, and the last is final research. The elementary school students in Gugus VIII Buleleng District who were in the fifth grade became the population in this study. The sample is determined by using random sampling. From 7 classes, 4 classes were selected, namely 2 classes as experimental groups including SD Negeri 1 Penarukan and SD Negeri 3 Penarukan with a total sample of 29 students, and 2 other classes as control groups including SD Negeri 5 Penarukan and SD Negeri 1 Penglatan with a total sample of 26 students. The problem-based learning model with Balinese local wisdom was implemented in the experimental group schools and the conventional learning model was implemented in the control group schools.

In this study, the independent variable is the problem-based learning model with Balinese local wisdom, and the dependent variable in this study is scientific literacy. Data about students' scientific literacy are the data that collected in this study. The method of test was used to collect the required data. The research instrument that is used in this research is the scientific literacy test. This test was given after giving treatment using problem-based learning model with Balinese local wisdom to the experimental group. A scientific literacy test consisting of 30 item questions with multiple choice type was used to collect data about students' scientific literacy. The grid of the scientific literacy test with heat and its transfer material can be seen in Table 1. The scientific literacy test has a reliability of 0.79 so it was used in this study.

Table 1. The Grid of Scientific Literacy Test

Scientific Literacy Indicators	Question Item Number
Evaluate the use and misuse of scientific information	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Problem solving using quantitative skills, including probability and statistics	14, 15, 16, 17, 18, 19, 20, 21
Justify conclusions, predictions, and inferences based on quantitative data	22, 23, 24, 25, 26, 27, 28, 29, 30

There are three steps of data analysis carried out in this study, namely data description, prerequisite analysis, and hypothesis testing. At the data description stage, it is described from a number of data, including mean, median, mode, standard deviation, variance, minimum score, maximum score, and range. Furthermore, the prerequisite analysis stage includes data normality test using Kolmogorov-Smirnov and variance homogeneity test using Levene Statistics. If the data is normally distributed and homogeneous, then proceed with hypothesis testing using two-way ANOVA.

3. RESULT AND DISCUSSION

Result

Based on the learning model that is used, students can be categorized into students who are taught with problem-based learning model with Balinese local wisdom (A1), and students who are taught with conventional learning model (A2). The calculation results of the description of scientific literacy data for each data category are presented in Table 2.

Table 2. The Calculation Results of Scientific Literacy for Each Data Category

Statistic	Data Category	
	A1	A2
Mean	73.03	66.19
Mode	67	67
Median	70	67
Standard Deviation	6.58	4.54
Variance	43.32	20.64
Maximum Score	87	77
Minimum Score	63	57
Range	24	20

Table 2 shows that the students in the experimental group who were taught by using a problem-based learning model with Balinese local wisdom had a higher average scientific literacy of 73.03 than the scientific literacy of students who were taught by using a conventional learning model of 66.19. So that in achieving scientific literacy, students in the experimental group are more excellent than students in the

control group. Before conducting hypothesis testing, it is necessary to carry out prerequisite analysis tests, which include data normality test and variance homogeneity test. This test was conducted with SPSS. Kolmogorov Smirnov test was conducted to determine the normality of the data, which resulted in a significance value of more than 0.05 (0.200>0.05) as shown in Table 3. This means that the science literacy data is distributed normally.

Table 3. The Normality Test Result of Scientific Literacy Data

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Standardized Residual for Scientific Literacy	0.076	55	0.200	0.986	55	0.789

Then the Levene Statistic test conducted to determine the results of the variance homogeneity test resulted in a significance value of more than 0.05 (0.189>0.05) as shown in Table 4. These results indicate that the science literacy of the learning model group is homogeneous.

Table 4. The Homogeneous Test Result

		Levene Statistic	**df1**	**df2**	**Sig.**
Scientific Literacy	Based on Mean	3.467	3	51	0.189
	Based on Median	2.517	3	51	0.119
	Based on Median and with adjusted df	2.517	3	46.160	0.120
	Based on trimmed mean	3.515	3	51	0.067

Based on the normality test results and homogeneity of variance of scientific literacy above, it can be said that the requirements for hypothesis testing with two-way ANOVA can be fulfilled. Therefore, hypothesis testing can be continued using two-way ANOVA, the results of which are presented in Table 5.

Table 5. Two-way ANOVA Result

Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	1159.978	3	386.659	16.286	0.000
Intercept	262787.993	1	262787.993	11068.668	0.000
Treatment	562.283	1	562.283	23.683	0.000
Cognitive Style	389.481	1	389.481	16.405	0.000
Treatment * Cognitive Style	107.337	1	107.337	4.521	0.038
Error	1210.822	51	23.742		
Total	270333.000	55			
Corrected Total	2370.800	54			

Based on Table 5 show the hypothesis testing that was conducted, the results showed that there was a significant difference in scientific literacy between students who were taught using a problem-based learning model with Balinese local wisdom and students who were taught using a conventional learning model (F=23.68 dan p<0.05). So, it can be concluded that H_0 is rejected and H_1 is accepted, namely there is a difference in science literacy between students who were taught using a problem-based learning model with Balinese local wisdom and students who were taught using a conventional model in fifth grade of elementary school students in Gugus VIII Buleleng District in the 2022/2023 academic year.

Discussion

Based on the analysis conducted, it is known that there is a significant difference in science literacy between students who learn through problem-based learning models with Balinese local wisdom and students who learn through conventional learning models. This is indicated by an improvement in scientific literacy in classes that are treated with a problem-based learning model with Balinese local wisdom compared to classes that use conventional learning models. This is because the problem-based learning model with Balinese local wisdom is a learning model that highlights real problems that happen in everyday life by integrating Balinese local wisdom in the learning steps. The problems that are raised will be used as a learning context for students in order to improve their higher-order thinking and problem-solving skills, so that this can also lead to an increase in students' scientific literacy (Muspita et al., 2013; Sari et al., 2021).

Balinese local wisdom that is integrated in this problem-based learning model is also able to improve students' understanding about local wisdom in Bali.

When students are given problems, they gradually solve the problems that are given by following the steps (syntax) of the problem-based learning model. This is because the improvement of scientific literacy is also influenced by the syntax of the problem-based learning model (Fauziah et al., 2019; Wijayanti & Wulandari, 2016). There are 5 steps in implementing a problem-based learning model, including orienting students to the problem, organizing students to learn, guiding individual and group investigations, developing and presenting work products, and analyzing and evaluating the problem-solving process (Arends, 2012; Sajidan et al., 2022). In the first step, the learning process students are given a problem, where the problem is in accordance with what happens in the real life of students, such as problems related to school activities and activities outside of school based on the reality encountered in their lives. The second step is directing students to learn. In this step, students are given the opportunity to seek information and provide ideas for problem solving individually or in groups. In the third step, the teacher is only a facilitator and media in problem solving activities. Students are motivated to find their own solutions and answers to these problems and are trained to be responsible for participating in the team. In the fourth step, students develop and make a report, and the fifth step re-evaluates the problem-solving process (Kurniawan et al., 2015; Triyana et al., 2014).

Providing problems in a real context as the first step in the learning process which will later have an influence on improving learning outcomes for the better. Learning that focuses on contextual problems will improve students' critical thinking skills which are certainly useful in the decision-making process related to problem solving solutions, so that this can also increase students' scientific literacy (Tamam & Subrata, 2022; Wijayanti & Wulandari, 2016). The achievement of better scientific literacy results when the problem-based learning model with Balinese local wisdom is applied is also due to the fact that students are excited and more motivated during the learning process. This is in accordance with Vygotsky's statement that with problem-based learning, students' knowledge as well as their interest and motivation can be continuously improved (Toharudin et al., 2011). Other study also states that in learning there is an interaction of interpersonal (social) and individual factors, namely students with teachers and their peers as the key to human development (Ergen, 2019). This is in accordance with the application of problem-based learning model with Balinese local wisdom that involves students with various learning activities in groups. In groups, group members work together to solve problems that are presented by the teacher (Fitriani, 2015). With such learning, students become easier to understand the material or problems, so that student learning activities can be carried out well and scientific literacy can be achieved.

The implications of the problem-based learning model make students actively involved to improve their ability to solve problems, thinking critically, and being able to develop their own knowledge by going through the process of solving a problem that has been implemented (Mustofa & Hidayah, 2020; Pramitha & Wahjudi, 2020). The problem-based learning model with Balinese local wisdom can improve students' scientific literacy by providing a problem that exists in everyday life, such as in the material of heat and its transfer, so that various problems relevant to the material can have implications for the formation of students' skills in solving problems while constructing new knowledge and better understanding the concepts taught. Then, the learning process by using the problem-based learning model with Balinese local wisdom links students with real problems in everyday life to be solved in learning following the steps of the learning model. Science learning that focuses on contextual problems will also improve students' critical thinking skills which are certainly useful in the decision-making process related to problem solving solutions, so that this can also have an impact on improving students' scientific literacy. In the learning process by using this problem-based learning model with Balinese local wisdom, students learn to apply science concepts to solve the real-life problems and improve their understanding of science concepts.

The researchers found that the effect of problem-based learning model on scientific literacy is seen from the achievement of the scientific literacy. The reason is from a theoretical point of view between problem-based learning models and conventional learning models where both have different characteristics seen from the definition of problem-based learning models is a learning approach that raises problems from the real world as a relationship for students to learn about how to solve problems and think critically, as well as to gain conceptual knowledge that is fundamental to the learning material (Anazifa & Djukri, 2017; Muspita et al., 2013). Then, by integrating Balinese local wisdom into a problem-based learning model has a positive influence on students' scientific literacy, because it allows students to connect scientific concepts with their everyday context. Through the use of examples from the surrounding environment, it will help students to understand the importance of science in explaining the natural phenomena that they observed. In addition, the use of Balinese local wisdom in science learning will make students more connected to the learning material and feel more motivated to learn because the material that they learn are relevant to their culture and environment.

The connection between problem-based learning models and scientific literacy is supported by research that was conducted previous study regarding the effect of problem-based learning model on students' scientific literacy skills, it was found that learning by applying problem-based learning model affects students' scientific literacy skills in all three domains of learning outcomes (Widiana et al., 2020). In addition, the research that was conducted by other study it was also found that there were differences in scientific literacy between students who were participating in the problem-based learning model and students who were participating in the expository learning model (Aiman, 2020). The research conducted by other study it was also found that the group of students who participated in the problem-based learning model had a better scientific literacy (Rahmadani, 2019). So that based on the results of the research conducted and supported by the opinion above, the problem-based learning model with Balinese local wisdom is useful for improving students' scientific literacy.

4. CONCLUSION

Problem-based learning model with Balinese local wisdom is implemented through several steps. It begins with giving problems to students, then organizing students to learn, guiding individual and group investigations, then developing and presenting work, and analyzing and evaluating the problem-solving process. So that the problem-based learning model with Balinese local wisdom is effective in improving students' scientific literacy compared to conventional learning models. The syntax of this learning model allows students to participate more actively in learning by finding solutions to problems. Teachers can use problem-based learning models with Balinese local wisdom in teaching science to overcome students' low science literacy. In addition, researchers are advised to conduct further research by implementing problem-based learning models with Balinese local wisdom on other science topics using larger samples, different types of assessments, and involving other psychological variables.

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