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THE INFLUENCE OF THE PROBLEM BASED LEARNING MODEL ON ELEMENTARY SCHOOL STUDENTS SCIENCE SELF-EFFICACY

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Abstract

This research aims to determine the effect of problem-based learning models on elementary school students' science self-efficacy. This study is a quasi-experimental study with a nonequivalent control group design using the Independent T-Test hypothesis test. The subjects of this study were 47 sixth grade students of SD Negeri 021 Sungai Kunjang. The research data were taken in qualitative form. The results of this study are the acquisition of students' science self-efficacy scores in the experimental class, namely 208 in the pre-test, and 201 in the post-test, while in the control class, the pre-test score was 183, and the post-test was 181. The results of the hypothesis test showed a 2-tailed sig value of 0.406 (> 0.05) so that H0 was accepted and Ha was rejected. This is due to the limitations of the study and the complex concept of self-efficacy and requires long-term and consistent intervention, so that the impact can be seen more optimally. The dimensions of science self-efficacy also

have a strong role in forming good SSE, so that the intervention given needs to pay attention to all dimensions evenly.

Keywords: Problem Based Learning, Science Self Efficacy, Elementary School Students

Abstrak

Penelitian ini bertujuan untuk mengetahui pengaruh model problem based learning terhadap science self efficacy siswa sekolah dasar. Penelitian ini merupakan penelitian kuasi eksperimen dengan desain nonequivalent control group menggunakan uji hipotesis Independent T-Test. Subjek penelitian ini adalah siswa kelas VI SD Negeri 021 Sungai Kunjang berjumlah 47 orang. Data penelitian diambil dalam bentuk kualitatif. Hasil penelitian ini ialah perolehan nilai science self efficacy siswa pada kelas eksperimen yaitu 208 pada pre-test, dan 201 pada post-test, sedangkan pada kelas kontrol, diperoleh nilai pre-test 183, dan post-test 181. Hasil uji hipotesis menunjukkan nilai sig 2-tailed 0,406 (>0,05) sehingga H0 diterima dan Ha ditolak. Hal ini terjadi dikarenakan adanya keterbatasan penelitian dan konsep self efficacy yang kompleks serta membutuhkan intervensi dalam waktu panjang dan konsisten, sehingga dampaknya dapat terlihat lebih maksimal. Dimensi-dimensi science self efficacy juga memiliki peranan kuat untuk membentuk SSE yang baik, sehingga intervensi yang diberikan perlu memerhatikan keseluruhan dimensi secara merata.

Kata Kunci: Model Pembelajaran Berbasis Masalah, Efikasi Diri Sains, Siswa Sekolah Dasar.

INTRODUCTION

The stages of cognitive development of children formulated by Jean Piaget are divided into 4 parts, namely sensory motor (0-2 years), pre-operational (2-7 years), concrete operational (7-11 years), and formal operational (12-15 years) (Marinda, 2020). At the formal operational stage, children have been able to think complexly and abstractly and have been able to solve problems with logical thinking (Magdalena et al., 2023). All stages of children's cognitive development are golden ages because children's development is influenced by the processes that have been passed through previously. Elementary school as the initial foundation for children's formal education plays an important role in forming the competencies needed in the future, so this is very important to pay attention to.

The Indonesian Ministry of Education, Culture, Research and Technology in December 2023 reported the results of the 2022 PISA (Program for International Student Assessment), which stated that there was a decline in international learning outcomes due to the Covid-19 pandemic. Specifically, the results of science literacy in Indonesia decreased by 13 points, so efforts are needed to improve learning activities in Indonesia (Kemendikbudristek, 2023). Science is one of the fields that can support a career as there is an increase in demand for jobs in

the field (Haerani & Erna, 2022). This shows that science as a field of study has an important role, but at the same time still requires efforts to support the increase in science literacy itself, one of which is by fulfilling competencies in the field.

One effort that can be made to improve science competence is to form good science self-efficacy (SSE) in students (Nursa'ban & Ewisahrani, 2021). Science self-efficacy is a person's belief in successfully completing activities related to science (Carroll et al., 2023). This makes SSE one of the important foundations for someone to succeed in science because it influences their interest and motivation to act. In recent years, SSE has been considered to have a positive contribution to the formation of students' interest in science, motivated to be actively involved in science learning, including creating academic achievement in science learning (Carroll et al., 2023). Seeing this, it can be understood that SSE indirectly plays an important role in the process of achieving students' science achievements such as in PISA. However, there is still little research that directly examines the impact of problem-based learning on science self-efficacy in elementary school students, especially in Indonesia.

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The Organisation for Economic Cooperation and Development (OECD) formulated competencies included in Science literacy used in PISA. This includes the ability to explain phenomena scientifically, develop and evaluate scientific investigation designs, critically interpret scientific data and evidence, conduct research, evaluate, and use scientific information in decision-making (OECD, 2023). These competencies can be formed starting from a small scope of children's learning, namely learning in the classroom. Teachers as facilitators have the capacity and obligation to organize learning strategies according to students' needs. One learning strategy that can support the formation of science competencies is by implementing a learning model that trains students' critical thinking skills, such as the problem-based learning model (Suryaningsih & Koeswanti, 2021).

Problem-based learning is a student-centered learning model that aims to develop students' problem-solving skills through independent learning as a lifelong culture and the formation of teamwork skills (Ali, 2019). The PBL model was first developed by educators from McMaster University in the 1960s as an approach to medical education learning. The PBL model was then developed as a learning approach that makes students the center of learning and

becomes a means of forming students' critical thinking skills (Thorndahl & Stentoft, 2020). The application of the PBL model in classroom learning can help students to learn independently (Susilowati, 2018) and train their critical thinking skills (Mariskhantari et al., 2022) through activities such as analyzing problem topics, thinking about and determining solutions, and conducting evaluations.

This study aims to determine the effect of the problem based learning model on elementary school students' science self-efficacy. Through Bandura's theory, it is known that self-efficacy is formed through 4 sources, namely mastery experience, vicarious experience, verbal persuasion, and emotional states. Mastery experience as the largest source can be given by giving students the opportunity to be directly involved in learning in the classroom. The problem based learning model which has the concept of student-centered independent learning is expected to be able to provide a good learning experience for students in order to form good science self-efficacy, as well as form good science competencies in students. Based on the theoretical framework, there is a positive influence of the application of the PBL model on improving elementary school students' SSE.

METHODS

This type of research is a quasi-experimental with a nonequivalent control group design. This design is a research design that provides a pre-test and post-test to measure the condition of the object before and after being given treatment. The experimental group and control group in this research design were not selected randomly (Sugiyono, 2017). This is because the research subjects have been formed in one complete group in the same class, in addition, by using existing groups it is expected to help the research process so that subjects can behave more naturally and purely because they are in accordance with their daily learning environment. In this study, pre-tests and post-tests were conducted to measure the level of science self-efficacy of each group. The treatment given to each group was different, namely the problem-based learning model in the experimental group, and the conventional model in the control group.

Table 1. Nonequivalent Control Group Design

Group	***Pre-Test***	**Treatment**	***Post-Test***
Experiment	O_1	X	O_2
Control	O_3		O_4

The population in this study were all students of State Elementary School 021 Sungai Kunjang, Samarinda City for the 2023/2024 academic year. The sample in this study were 22 students in class VI-B and 25 students in class VI-D. The decision on the sample group used in this study was made after conducting an interview with the vice principal who stated that the concept of grouping students into classes in this school was carried out evenly regardless of the level of competence of each student, so that overall the abilities of each class were the same. In addition, the researcher also reviewed the students' academic grades, especially in science subjects, and it was found that the academic grades of the two selected classes were in the same range, namely 80-90. Furthermore, the study was continued by selecting class VI-B as the

experimental class which would be given the problem-based learning model treatment, while class VI-D as the control class would be given the conventional model treatment. The determination of the research sample was carried out using the purposive sampling technique with the need for samples at the formal operational cognitive stage due to the use of research instruments in the form of questionnaires with several complex questions so that research samples were needed that were able to think abstractly, were able to reason logically, and were able to draw conclusions from the available information.

The instrument used in this study was a questionnaire. This study adapted an instrument developed by Sarah Carroll, et al. called IS-SEC-Q (Irish Science Self-Efficacy Children's Questionnaire) (Carroll et al., 2020). The selection of this instrument was based on considerations of the development of this instrument which was created to measure science self-efficacy for children aged 11-12 years. This instrument was adapted by translating the original English instrument into Indonesian. This translation process was carried out using the help of translation technology in the Google application, then the equivalent words were adjusted again to make it easier for children to understand the questionnaire. The instrument that had been translated into Indonesian was then tested for validity and reliability on grade VI-A students at the same school, with the results of the validity of all items in the instrument being declared valid and reliable with a Cronbach's Alpha value of 0.954.

This instrument contains 5 sections, namely: (Section A) contains an assessment related to the field of study taken by students. This section is measured to determine students' beliefs in the field of study being studied. This section contains 4 statements that assess students' beliefs in the fields of science, mathematics, writing, and reading; (Section B) contains an assessment related to students' science learning outcomes (grades). This section is measured to determine students' beliefs in getting high grades in science learning; (Section C) contains an assessment related to the science material studied by students. This section is measured to determine students' beliefs in understanding the science material being studied; (Section D) contains an assessment related to the sources of self-efficacy owned by students. This section is measured to determine the mastery experience, vicarious experience, verbal persuasion, and emotional states that students have obtained; (Section E) contains an assessment related to students' ability to follow learning in class. This section is measured to determine students' self-confidence related to their problem-solving abilities. The categorization of levels in this instrument can be seen as follows (Azwar, 2016):

Table 2. Categorization Levels of Science Self Efficacy

Interval *Science Self Efficacy*	**Criteria**
X < (188-1,0 (47)) = X < 141	Low
(188-1,0 (47)) < X < (188+1,0 (47)) = 141 < X < 235	Currently
(188+1,0 (47)) < X = 235 < X	High

The hypothesis in this study was conducted by calculating the comparison of data between the experimental class and the control class. Hypothesis testing in this study was conducted using IBM SPSS 26 software. The significance level used in this study was $\alpha = 0.05$.

1. Normality Data Test

The normality test was conducted to determine the distribution of research data. This study used the Shapiro-Wilk normality test with a significance level (α = 0.05). This is because the small sample size of the study was less than 50 students so that the Shapiro-Wilk test was more ideal for detecting the normality of data distribution. The normality test proposed is if the significance value> 0.05, then the data obtained is stated to be normally distributed, conversely if the significance value <0.05, then the data obtained is stated to be not normally distributed.

2. Homogeneity Data Test

A homogeneity test is conducted to determine whether the characteristics of the data obtained are similar or not. This study uses Levene's homogeneity test (Test of Homogeneity of Variances) with a significance level (α = 0.05). This is because Levene's test can test the homogeneity between samples that receive intervention (experimental class) and do not receive intervention (control class). The homogeneity test proposed is if the significance value is > 0.05, then the data obtained is declared homogeneous, conversely if the significance value is <0.05, then the data obtained is declared non-homogeneous.

3. Research Hypothesis Test

Hypothesis testing is conducted to test the hypothesis or temporary assumptions that have been submitted. This study uses the Independent T-Test with a significance level (α = 0.05). This is because the Independent T-Test can determine the differences between the two sample classes and see the impact of the PBL model itself to be compared with classes that are not subject to intervention. The hypothesis in this study is that the application of the problem based learning model has an influence on the science self-efficacy of elementary school students. The statistical hypothesis in this study is:

H_0 : There is no difference in the science self-efficacy scores between students who received the problem-based learning model treatment and those who did not.

H_a : There is a difference in the science self-efficacy scores between students who received the problem-based learning model treatment and those who did not.

RESULTS AND DISCUSSION

The research was conducted by giving a pre-test to each experimental class and control class. Pre-tests were conducted to determine students' science self-efficacy before being given treatment. The results of the pre-test can be seen as follows:

Table 3. Pre-Test Data of Experimental Class and Control Class

Category	Number of Students	
	Experimental Class	Control Class
High	2	1
Currently	20	22
Low	0	2
Total	22	25

Based on the table above, it can be seen that the average science self-efficacy of students in the experimental class and control class is in the moderate category. Based on the values obtained, the average science self-efficacy value of students in the experimental class is 208, and in the control class is 183. So it can be seen that the pre-test score of the experimental class is higher than the control class.

The research was continued by providing treatment to each class. The treatment given was science learning that raised the phenomenon of flooding as an example of environmental damage due to human activities in the material on Natural and Artificial Appearances. This is done in order to provide education to students so that they can have sensitivity and awareness of the conditions of the surrounding environment so that students have the desire to play a role in improving the environment (Suhartini & Haerani, 2024). In the experimental class, the implementation of learning is carried out in accordance with the syntax of the problem based learning model (Hotimah, 2020), namely: (1) providing orientation about the problem to students. At this stage, students are given the topic of flooding problems due to human activities, as a problem that must be solved; (2) organizing students in learning. At this stage, the researcher organizes students to form student study groups; (3) guiding individual and group investigations. At this stage, students in groups seek information and discuss related to the given problem topic. Students are provided with the internet and books as sources of information. The researcher guides the student investigation process by providing directions related to the stages of problem solving and division of work tasks; (4) developing and presenting the results of the work. At this stage, students are asked to write a report on the results of problem solving and present the results in front of the class in groups; (5) analyzing and evaluating the process and results of problem solving. At this stage, the researcher together with the students conducts analysis and evaluation related to the problem solving processes carried out by students. Based on this learning, it is known that there are several students who are less actively involved along with students who seem more prominent in group learning. In the control class, learning is carried out conventionally by providing the same material as in the experimental class. Learning in the control class went quite well. Students listened to the teacher's explanation in an orderly manner even though they sometimes seemed less focused. On several occasions, students answered when asked, but the initiative to express opinions or questions still tended to be lacking.

After giving the treatment, the research was continued by giving a post-test to each experimental class and control class. The results of the post-test can be seen as follows:

Table 4. Post-Test Data of Experimental Class and Control Class

Category	**Number of Students**	
	Experimental Class	**Control Class**
Tall	2	1
Currently	20	23
Low	0	1
Total	22	25

Based on the table above, it can be seen that the average science self-efficacy of students in the experimental class and control class is still in the moderate category. There is a change in the average value of science self-efficacy of students in the experimental class, which is 201, so it can be seen that there is a decrease in value of 7 points. In the control class, there is also a change in the average value of science self-efficacy to 181, and this also experienced a decrease in value of 2 points. So it can be seen that after the treatment, the science self-efficacy of students in the experimental class and control class decreased.

The study was then continued by analyzing the data that had been obtained. Before conducting a hypothesis test, the data obtained was tested for normality and homogeneity first. This study uses the Shapiro-Wilk data normality test, the data homogeneity test uses the Lavene test, and the hypothesis test uses the Independent T-Test. The results of the hypothesis test are presented in Table 5, Table 6, Table 7.

Table 5. Normality Data Test Results

Statistics	**Experiment**		**Control**	
	Pre-Test	***Post-Test***	***Pre-Test***	***Post-Test***
Sig.	0,714	0,157	0,099	0,973
Shapiro-Wilk	Sig>0,05	Sig>0,05	Sig>0,05	Sig>0,05
Conclusion	Normal	Normal	Normal	Normal

Table 6. Homogeneity Test Results

Statistics	**Pre-Test for Experimental Class and Control Class**	**Post-Test for Experimental Class and Control Class**
Sig.	0,818	0,672
Levene's	Sig>0,05	Sig>0,05
Conclusion	Homogeneous	Homogeneous

Table 7. Hypothesis Test Results

Independent T-Test	**Information**
Criteria	Sig.(2-tailed0>0,05
Sig.(2-tailed)	0,406
Decision	H_0 accepted

Based on the results of the hypothesis test with the independent t-test, the significance value (2-tailed) obtained is 0.406, because the value is > 0.05, it can be seen that there is no effect of the problem-based learning model on the science self-efficacy of elementary school students at Negeri 021 Sungai Kunjang, Samarinda City.

Science self-efficacy is a complex concept of self-knowledge and is greatly influenced by various factors and conditions experienced by a person. According to Albert Bandura, the formation of self-efficacy tends to be permanent and does not change easily (Lianto, 2019). Based on the data obtained, it is known that students are less confident in their abilities in learning science. Students consider science to be a difficult lesson and require critical thinking.

This perception is formed through learning experiences in their learning environment (Rifly, 2023).

The results of the study were then analyzed based on the dimensions of science self-efficacy. In the general academic self-efficacy dimension, it is known that students' beliefs about science are at a moderate level, and only 4 students were individually known to have increased after being given PBL learning. In the performance-specific SSE dimension, overall students were not very confident in being able to get high scores in science subjects. Of the total 22 students, only 6 students felt confident in being able to get a perfect score (100). In the knowledge-based SSE dimension, before PBL learning was given, it was known that students felt confident in understanding the science material taught, and after learning was carried out only 7 students felt an increase in understanding the material. In the sources of SSE dimension, this is related to the sources of self-efficacy formulated by Bandura, namely *mastery experience, vicarious experience, verbal persuasion,* and *emotional states*.

Albert Bandura previously said that mastery experience is the greatest source in the formation of a person's self-efficacy. Poor learning experiences accompanied by a lack of variation in learning styles, in this case science learning, are perceived by students as less enjoyable learning experiences and give the impression that science is a difficult field of study, so that students tend to be less motivated and less interested in learning science (Andriani et al., 2022). In line with this, this study also obtained results in the form of students who felt less confident in getting high scores in the range of 80-100 in science learning. This belief is different from the academic grades obtained by students when studying in class. The average academic score of students in the science field of study actually showed a score of 88, which means that academically students were able to get these high scores. Through the assessment of this aspect, it is known that students are afraid of failure so they tend to give safe self-assessments (OECD Library, 2018). This difference in direction between self-efficacy and academic grades can occur as stated by Sternberg & Grigorenko who stated that students who fail in learning are thought to have excessive self-confidence which affects their learning outcomes (Nani, 2019). Therefore, based on this, it was found that there are other factors related to students' success in learning science, namely that some students who are less confident can actually be motivated to try hard in their learning so that they can provide better learning outcomes.

Students' skill-based science self-efficacy, as one of the dimensions of science self-efficacy, experienced an increase in average scores after being given problem-based learning. In the experimental group as a group given the PBL model intervention, 12 out of a total of 22 students in the group felt an increase in their problem-solving abilities. The problem-based learning model that is oriented towards problem solving carried out by students has been proven to be able to improve students' problem-solving abilities. The stages of problem solving in the problem-based learning model, such as seeking information from various sources, thinking about solution ideas, testing solution ideas, and conducting evaluations, are considered by students to be able to help them improve their problem-solving abilities to be better (Hasanah et al., 2020). The time constraints in this study when implementing the problem-based learning model were also analyzed as one of the factors in the less than optimal formation of students' science self-

efficacy. Self-efficacy is formed through a long and mutually influencing process. The application of the problem-based learning model in this study was considered less than optimal so that the sources of science self-efficacy such as mastery experience and vicarious experience experienced by students also still seemed lacking. Science self-efficacy interventions should be carried out over a long period of time and consistently so that the influence of PBL can be formed and seen more optimally.

The student study groups in this study were formed heterogeneously with the hope of improving students' learning abilities through group collaboration (Pratiwi et al., 2023). However, when learning took place, there were students who were less actively involved in the group and gave responsibility for tasks to their group members who were considered to have better abilities. This then gave the impression that learning was not running collaboratively, communicatively, and cooperatively so that the benefits of the PBL model were not optimally felt by students (Hotimah, 2020). The passive attitude of students occurred due to several factors such as lack of self-confidence and lack of motivation in learning (Hendrizal, 2020). The PBL model should be one strategy to provide direct learning experiences for students. The opportunity to be actively involved in problem solving including the processes in it such as observing existing problems, then thinking critically about what solutions can be done to overcome these problems should be utilized well by students. In dealing with this, future research can carry out strategies such as creating a framework in student study groups, where there is a clear mapping of the tasks of each group member so that the work boundaries and student collaboration flow run optimally. Verbal persuasion is also important in forming self-efficacy. Students need to get positive affirmation from their learning environment to create good self-confidence, such as affirmation from teachers, parents (Wahiddah & Julia, 2022), and peers (Santi & Khan, 2019). Teachers as direct supervisors in the child's learning process at school can consistently provide affirmation to build and increase children's confidence, especially in matters related to science. In addition, peers also play an important role, especially in learning activities with this PBL model. The motivation given by peers to each other can increase students' confidence to contribute to group work.

In addition, there are other sources that affect students' science self-efficacy, namely students' emotional conditions. Students with unstable emotional conditions will experience difficulties in learning (Adi Wahyuni & Candra Sayekti, 2023). As discussed in the previous paragraph, it is known that students experience science as a difficult learning experience. Science subjects are considered to have a high level of abstraction difficulty so that students tend to feel anxious (Parikesit, 2020). This condition is formed from students' learning experiences at previous levels, so there needs to be an evaluation of science learning which should be packaged in a fun way and not seem full of pressure. The problem-based learning model, which trains students through problem solving in everyday life, provides opportunities for students to experience meaningful learning so that it can be implemented in real life. In relation to the formation of science self-efficacy, the concept of PBL which is centered on students in the form of group learning provides students with direct problem-solving experiences which are expected

to help form the mastery experience experienced by students. In addition, group learning (formed heterogeneously) can stimulate the formation of SSE in the vicarious experience aspect through peer teaching practices, as well as in the verbal persuasion aspect where most of the student interactions throughout the learning are with their group mates so that verbal persuasion opportunities can be given by students to each other. The formation of the skill-based aspect, in this case the problem-solving ability, is obtained by students through the problem-solving process taught in PBL learning itself.

Overall, research on the PBL model of science self-efficacy, especially in elementary school students, still needs to be carried out in the future by paying attention to the details of aspects that influence SSE itself. This requires more intensive and complex supervision and assessment to find out clearer and more in-depth results. Although the mastery experience and skill-based aspects in this study were given through PBL learning, because the intervention period was still not long enough, the impact on other aspects could not be seen significantly. In addition, it is also because the condition of SSE is susceptible to change if it is not in a consistent situation. Other aspects such as emotional conditions and verbal persuasion are also known to have a strong role in the formation of good SSE so it is important to provide intervention in research.

Research on science self-efficacy in elementary school students still needs to be carried out in the future, by paying attention to several things such as a longer, more intensive and consistent intervention period for all dimensions of science self-efficacy evenly. Several other learning models in the form of cooperative learning other than PBL can be studied to see their effect on increasing science self-efficacy. Measurement of science self-efficacy can also be elaborated using qualitative methods such as interviews and observations.

CONCLUSION

The problem based learning model in this study did not have a significant effect on elementary school students' science self-efficacy. This is because the concept of science self-efficacy is quite complex because it is formed by many aspects that influence each other. Learning with the PBL model in this study only has an impact on students' problem-solving abilities, where this is only one aspect of the total five aspects that form science self-efficacy. Research related to the effect of PBL on elementary school students' science self-efficacy still needs to be carried out in the future, by paying attention to and providing intervention evenly on all aspects that form SSE itself.

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