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Analysis of Problem Based Learning Model on Students' Cognitive Intelligence in Mathematics Class IV Elementary School

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The primary objective of this study is to investigate the impact that the PBL learning paradigm has on the cognitive ability of pupils. Quantitative techniques and experimental approaches are used in this kind of study. This design is a quasi-experimental one with a nonequivalent control group. SDN 111 pupils make up the whole population of this area, which has a total of 300 individuals. SDN 111 Pekanbaru provided the samples, which consisted of 25 pupils from class IV A and 25 students from class IV B. The method of sampling is called probability sampling, and it is combined with plain random sampling. The instrument is a description exam questions. The findings of the research using the independent sample t test demonstrate that Tcount = 2.840 and Ttable = 2.007, where Tcount is bigger than Ttable (2.840 > 2.007). Given these findings, we may conclude that H1 is correct and H0 is incorrect. To summarize, the implementation of the PBL model has a positive impact on the level of cognitive intelligence exhibited by primary school children.

1. Introduction

Piaget emphasized that in general, children are always curious and try to understand the world around them to create representations of the environment they experience (Ardianti et al., 2021; Marinda, 2020). According to him, the concrete operational stage includes children in elementary schools aged between 7 and 8 years and 12 and 13 years (Khiyarusoleh, 2016). During the educational process, children experience difficulties understanding hypothetical or abstract concepts; in other words, they need concrete examples to think logically. Cognitive development is one of the things that happens to children throughout their lives (Khoiruzzadi & Tiyas, 2021). The belief that children's behavior can be influenced by their cognitive intelligence is the philosophical basis for the

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cognitive intelligence approach. During the Middle Ages, when the expansion of scientific knowledge was just beginning, researchers became interested in human cognitive development. Cognitive development refers to the process of growing intellectually in all aspects, including the capacities to reason, remember, memorize, find solutions to real-world problems, get ideas and be creative, and so on. Events also fall into this category (Arfiani & Latipah, 2021; Bujuri, 2018). Like other aspects of development, cognitive development progresses step by step towards perfection or maturity. That is, cognitive refers to a child's intelligence in thinking and solving problems (Marinda, 2020).

Learning is essentially a process of changing behavior. The next generation must be motivated to encourage students to complete their learning process. Students learn to understand knowledge and use it as a basic need in the era of globalization. Students must be trained and practiced since elementary school in solving problems in their environment so that they are accustomed to using their minds to solve problems (Haryanti & Febriyanto, 2017; Nurcholis et al., 2013).

Learning activities in elementary school education generally increase students' cognitive intelligence. Cognitive processing plays an important role in making correct, fast, and effective decisions. Cognitive intelligence includes thinking processes. There are several forms of cognitive intelligence, including the ability of students to explore, describe, and solve problems. By using their cognitive intelligence, students are able to make correct assumptions in order to make the right decisions (Wati et al., 2022). It was discovered that fourth grade students at SDN 111 Pekanbaru were less active during the learning process, particularly in mathematics. The problems that arise are that students tend to accept the information provided uncritically and do not give serious responses, and the learning process is less interesting, causing students to feel bored, because the teacher is less creative in providing learning.

The problem-based learning (PBL) learning model is one of the approaches taken to improve students' cognitive abilities so that they are better able to deal with the problems described above. This is because PBL is the latest strategy as well as a learning model that seeks to improve conventional techniques that have long existed. Plato and Socrates asked their students to independently acquire knowledge, look for new ideas, and discuss them, so that this PBL learning model is not entirely new (Murtihapsari et al., 2022). According to Duch in (Burhana et al., 2021) argue that the problem-based learning model is a learning model that is characterized by real problems as contexts for critical thinking and the ability to solve problems and gain knowledge.

In the field of education, a problem-solving strategy known as problem-based learning (PBL), which was being developed at the time, became very widespread. Don Woods, a chemistry professor at McMaster University in Ontario, Canada, is credited with being the first to use the term "problem-based learning", which he coined in the 1960s (Mayasari et al., 2015). Students are given the opportunity to actively participate in the process of acquiring knowledge and understanding newly acquired concepts. In addition, students are involved in the process of

finding solutions to problems using the scientific method, which allows students to gain immediate knowledge related to the problem being studied (Hotimah, 2020; Sari et al., 2018).

The Ministry of Education and Culture recognized in 2013 that problem-based learning is an educational method that encourages students to learn by presenting problems that are relevant to their lives (Hendra, 2021). PBL is learning that is obtained during the process of understanding the solution to a problem (Masrinah et al., 2019; Yulianti & Gunawan, 2019). PBL is a type of learning strategy that is student-centered (Malikha, 2018; Nopita, 2017; Rahmadani, 2019). Students gain experience solving real-world problems through project-based learning (PBL), which also emphasizes communication, collaboration, and the use of available resources to generate ideas and develop reasoning abilities (Assegaff & Sontani, 2016; Kusnandar et al., 2020; Nafiah & Suyanto, 2014).

Based on the problems above, it is necessary to improve the quality of education in various ways. Improving the educational model used previously is one of these options. Contextual learning refers to teaching strategies that emphasize students acquiring knowledge through their own independent thinking processes and center instruction around them. The application of the problem-based learning (PBL) model is a student-centered learning strategy that teachers can use to increase the level of cognitive intelligence of their students. The use of the PBL model aims to improve students' cognitive intelligence.

This model is expected so that students can increase their cognitive intelligence in the learning process. The purpose of this review is to examine further the use of learning models with students who can motivate and play an active and responsible role in the teaching and learning process. The target of this review is the use of the PBL model from several literature studies to improve students' cognitive intelligence. This review is considered very important to study because not much has been said about the importance of this model by comparing the results of previous studies. In addition, it is hoped that this literature study will obtain information about one of the uses of learning models to improve students' cognitive intelligence.

2. Methodology

Quantitative experimentation is the method used for this research (Wati et al., 2022). The design is quasi-experimental and is a type of inequivalent control group design (Kusnandar et al., 2020). SDN 111 students make up the entire region's population of 300 people. SDN 111 Pekanbaru provided a sample consisting of 25 students in IV A and 25 students in IV B. The sampling method is called probability sampling combined with simple random sampling. The data collection technique is a test. The evaluation tool consists of essay questions that must be answered by participants. Normality testing, homogeneity testing, and hypothesis testing are the analytical methods used.

3. Results and Discussion

To find out students' cognitive intelligence in mathematics, a written test was carried out in the Experiment class. After finishing presenting the results of the group's work, the teacher gives a written test. This can be seen in Figure 1.

Figure 1. Students in an Experimental Class Taking a Written Test

In Figure 1. The teacher explains to students about mathematics subject matter in groups and then writes test questions on the blackboard. The test questions are done by students to measure their cognitive intelligence abilities. This test was only given to the experimental class students, while the control class was not given treatment. The description of the cognitive intelligence scores of the experimental and control class students is shown in Table 1.

Table 1. Experiment Class Results

	Statistics	
	Experiment Class	**Control Class**
N	25	25
Mean	86,862	80,961
Median	87	82
Modus	82	89
SD	7,632	7,734
Minimum	75	67
Maximum	100	90

Source: 2022 Observation Processed Data

Based on Table 1. The calculation of the cognitive intelligence scores of experimental class students has a value range of 75 to 100 with a mean of 86.862. Meanwhile, the control class has a value range of 67 to 90 with a mean of 80.961. The standard deviation is lower than the mean, indicating that the distribution of cognitive intelligence score data for experimental and control class students has no gap between high scores and low scores.

The prerequisite tests include the normality test, homogeneity test, and hypothesis test. The normality test is used to determine whether the data used is normally distributed or not (Wati et al., 2022). The normality test uses the Lilliefors test at a

significant level of = 0.05. If $L_{count} < L_{table}$, then H1 is accepted and H0 is rejected. The following is an analysis of the normality test as shown in Table 2.

Table 2. Normality Test Results Using the Liliefors Method

Value	L_{count}	L_{table}	Decision	Conclusion
Experiment	0,140	0,180	H1 is accepted	Normal
Control	0,110			

Source: Processed Data for 2022

Based on Table 2. The value of Lcount has a lower value than Ltable. If $L_{count} < L_{table}$, then H1 is accepted, that is, all data in both classes have a normal distribution. The homogeneity test is useful for proving whether or not a dataset is homogeneous (Wati et al., 2022). The test is based on a significant level of 5%; if the data is significant and the value is > 5%, then H1 is rejected; conversely, if the data is significant and the value is < 5%, then H1 is accepted. So, the conclusion is that if H1 is accepted, then the data is homogeneous, and if H1 is rejected, then the data is not homogeneous. The results can be seen in Table 3.

Table 3. Homogeneity Test Results

Class	Varians	F_{count}	F_{table}	Information
Experiment	58,440	1,020	1,930	Homogen, H1 is accepted
Control	59,530			

Source: Processed Data for 2022

Based on Table 3. The Fcount value of the data has a lower value than F_{table} ($F_{count} < F_{table}$), so H1 is accepted, which means that the overall data is homogeneous. The t test on independent samples can be used to investigate hypotheses and determine whether the experimental group and the control group have significantly different levels of mathematical ability. In conclusion, H1 is accepted if tcount is greater than ttable. This shows that there are differences between the experimental class and the control class. The results are as shown in Table 4.

Table 4. Independent Sample Test Results

Class	T_{table}	T_{count}	Conclusion	Decision
Experiment	2,010	4,740	H1 is accepted	H1 is accepted, meaning the PBL model on students' cognitive intelligence
Control		2,330		

Source: Processed Data for 2022

Based on Table 4. The results of the cognitive intelligence score of the experimental class students were 2,370, the control class was 2,210. The comparison between the two classes is 160. This proves that the actions given to the experimental class provided a significant increase in scores. The increase in student scores at the learning stage explains that student learning outcomes can increase because gaining knowledge can give a good impression during learning and increase student motivation and interest in learning very well. Based on the

hypothesis test using the independent sample t test, the total cognitive intelligence score is not the same in the experimental class and the control class. Obtaining an independent sample t test proves T_{count} = 2.840 and T_{table} = 2.007. Where T_{count} = 2.840 is greater than T_{table} = 2.007, then Ho is rejected. Thus, it can be concluded that the PBL model is effective in improving the cognitive intelligence of fourth grade elementary school students at SDN 111 Pekanbaru.

4. Conclusion

Based on the discussion above, it is concluded that the PBL model is effective in improving students' cognitive intelligence. On the basis of these findings, one of the recommendations that can be made is for educators to use the PBL model as a problem-based learning model linked to real life. Other researchers can use the PBL learning model as a substitute that can be used to prove the cognitive intelligence of elementary students.

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