Pancasila International Journal of Applied Social Science
E-ISSN 2988-0750 P-ISSN 2988-0769
Volume 3 Issue 01, January 2025, Pp. 129-140
DOI: https://doi.org/10.59653/pancasila.v3i01.1384

The Effect of Problem-Based Learning Model on the Ability to Recognize Geometric Shapes in Children Aged 5-6 Years

Munirah Saining[1], Rusmayadi[2]*, Muhammad Akil Musi[3], Abdul Halik[4]
State University of Makassar, Indonesia[1]
State University of Makassar, Indonesia[2]
State University of Makassar, Indonesia[3]
State University of Makassar, Indonesia[4]
Corresponding Email: rusmayadi@unm.ac.id*

Received: 24-12-2024 *Reviewed: 10-01-2025* *Accepted: 25-01-2025*

Abstract

This study aims to find out the overview of *the problem-based learning* (PBL) learning model on the ability to recognize geometric shapes of children aged 5-6 years and to determine the influence *of the Problem Based Learning* (PBL) model on the ability to recognize geometric shapes of children aged 5-6 years. The approach used is a quantitative approach with a type of *Quasi Experimental* research with a research design, namely *a nonequaivalent control group* design. The population in this study is children aged 5-6 years. The sampling in this study is *cluster random sampling*. The sample in this study is 14 children with 7 children as the experimental group and 7 children as the control group. The data analysis techniques used are *descriptive statistical analysis* and *non-parametric statistical* analysis. The results of data analysis obtained Asym (2-tailed) = 0.017 < 0.05 HI accepted and H0 rejected, meaning that the geometry ability of children who were treated *with the problem-based learning model* in the experimental group experienced significant development compared to the control group. This shows that the problem-based learning learning model *significantly influences* the geometry ability of children aged 5-6 years.

Keywords: model, problem-based learning, geometry ability

Introduction

Playing with geometric pieces is an exploratory activity on geometric shapes and their arrangement. This activity aims to stimulate children's sensitivity to the main elements of construction. With this activity, children are required to be creative in recognizing geometric shapes, designing geometric shapes, and creating new shapes using geometric pieces (Gardner, 2008).

Based on these problems, in order for children's ability to recognize the concept of geometric shapes to develop optimally, it is necessary to innovate in the learning process.

Innovation in learning is by *problem-based learning (problem-based learning), which is a way to overcome* boring learning, where this learning is a pattern of interaction between children and teachers in the classroom (Mohammed et al., 2024). The problem-based learning approach is derived from the theory that learning is a process in which children actively construct knowledge (Sadia, 2007: 19). From some of the results of this survey, the achievement of mathematical skills is something that must be considered because it is an important field in an individual's life to stimulate analytical skills, critical and logical thinking skills and foster creative thinking skills in daily life (Clements et al., 2022; Pasiningsih, 2022; Putri, 2020).

In activities to optimize mathematical skills, especially in recognizing geometry, can be pursued through education. Education is considered one of the ways to develop individual potential. This education will be more optimal if it is provided in the fundamental period (Alpian et al., 2019; Annisa et al., 2020; Santrock, 2019) This statement is supported by Gardner (2011) who states that a person's fundamental period is early childhood when the brain of children aged 0-8 years develops as much as 80%, the formation of neurons in the brain occurs because children absorb and manage a lot of information from their daily activities (Sylva et al., 2009; Ulferts et al., 2019).

Therefore, to improve the results of mathematical skills, providing the right stimulation from an early age is necessary in one of the ways that can be taken through early childhood education (Chueh & Kao, 2024). The skills in this field that are introduced to early childhood are algebraic patterns, numbers, calculation operations, geometry, and Jackman (2012) problem-solving activities. Several studies have shown that early childhood often has difficulty recognizing geometric shapes (Clements et al., 2022; Hawes et al., 2017; Putri, 2020; Rittle-Johnson et al., 2019). This is due to the activities carried out by teachers not in accordance with the principles of early childhood education, for example the selection of inappropriate learning models (Norton & Nurnberger-Haag, 2018; Putri, 2020) as a result, children's abilities and application of these abilities in daily life are less than optimal.

The implementation of educational activities, teachers are one of the determining factors for the success of achieving the goals that children achieve, but there is still an application of learning methods that are not varied by teachers in Indonesia (Maiza & Nurhafizah, 2019; Meilanie, 2020; Roza & Nurhafizah, 2020). In early childhood education, teachers provide worksheets to children as a learning activity of as much as 90% (Clements & Sarama, 2011), so the selection and application of varied learning models is needed to optimize children's abilities.

One of the models that can be implemented in early childhood is *the problem based learning* (PBL) model. In this model, there are problems presented in small groups so that the emergence of these problems can guide children in identifying, overcoming and explaining the solution of these problems (Jerzembek & Murphy, 2013; Marra et al., 2014; Ningsih et al., 2019). Children who have the ability to solve problems are considered to have excellent self-regulation in their daily lives (Kauchak, 2012) The PBL model is even considered to be able to improve student achievement at the secondary school level (Anazifa & Djukri, 2017; Chu et al., 2017; Schmidt et al., 2011) even at the undergraduate level (Junaidi et al., 2022) However,

an explanation of the influence of the PBl model on early childhood education is still needed (Putri, 2020).

Based on the description above, there is still a need for information about the influence of the PBL model on kindergarten. So, in this study, the researcher will see the influence of the PBL model on the ability to recognize geometric shapes, especially in kindergarten children aged 5-6 years.

Literature Review

Problem-Based Learning (PBL) Learning Model

Problem-Based Learning (PBL) was developed to assist children in solving problems and intellectual skills and provide opportunities for children to be responsible for the independent learning process while developing problem-solving skills.

> *Belland, Brian (2009) state that Problem-based learning is "Problem" +"based" +"learning". Let us look at each of these words. A problem is something that is problematic to the student; something that cannot be resolved with the current level of knowledge and/or way of thinking about the issues.*

PBL learning is learning that uses real problems that are ill-structured and open so that they can develop problem-solving and critical thinking skills and build new knowledge for children. Real (authentic) problems are triggers for children before they know formal concepts.Learning is carried out by presenting opportunities for children to get to know procedures and problem-solving skills by looking for as much information as possible related to the problem (Sari et al., 2024). PBL learning provides provisions for children to learn to understand problems and solve them so that students are really able to gain their own knowledge and experience. The purpose of PBL learning is to help children gain experience and change children's behavior, both in terms of quality and quantity. The behavior change in question is knowledge, skills and values or norms that function as a controller of attitudes and behaviors owned by children. (Rosfiani, Maisyaroh, et al., 2023)

The characteristics of PBL learning are that children must have responsibility in learning, problem simulations used in problem-based learning must be problem-structured and allow *for free inquiry.* learning must be integrated from different disciplines, what the child learns during independent learning should be applied back to the problem with reanalysis and resolution, the final analysis of what has been learned from the problem and the discussion of what concepts and principles that have been learned are essential, self-assessment and peer assessment should be carried out on the solution of each problem and at the end of each unit, Activities carried out in problem-based learning should be useful in the real world, children's exams should measure children's progress towards problem-based learning goals. (Sari et al., 2024)

Ability to recognize geometric shapes in children

Geometry is a branch of mathematics that must be studied and understood in depth because geometry is always used daily. According to Ismayati (2010:27), Geometry is the understanding of the concept of various geometric shapes, flat shapes, and spatial shapes. According to Kahfi (1996) geometry is a branch of mathematics that has been familiar to children since early age because geometry is around us in all visual objects. One of the aspects of early childhood geometry learning is exploring objects and their relationships. Children are able to recognize and name shapes, simple objects in the surrounding environment such as closets, tables, TVs, kites, etc. Getting to know the concept of geometry to build space can use media, one of which is model media. Model media has advantages that the senses can feel, be seen, and feel.(Divito et al., 2024)

According to Triharso (2013:50), building the concept of geometry in children starts by identifying shapes. Investigate the wake and separate the usual images. The initial basis for understanding geometry in children can also be by learning the placement concept, such as placing on the right, left, on top, and below (Javaid & Usmani, 2024). One of the alternative games that can be used to improve children's ability to recognize geometric shapes is to use a game of picking up and stacking (Ni et al., 2024). The steps in the game are that the child is asked to take the geometry pieces that have been prepared according to the teacher's cue. After the geometric pieces in the container are exhausted, the teacher asks the child to sown the geometric pieces on a base (Rosfiani, Fitriani, et al., 2023). Furthermore, the teacher gave affirmation to the child in the form of questions about geometric shapes that the child had taken and arranged. Through this game, children can learn geometric shapes directly and arrange geometric pieces into a favorite building shape.(Nirmala et al., 2024)

Factors that can influence children in recognizing geometric shapes are symbolic, intuitive, and spatial ability to know, understand, and apply the concept of geometric shapes in daily life. According to Jamaris (2006:44) the basic mathematical ability in children is in the pre-operational phase which is colored by the development of symbolic thinking skills. Symbolic and spatial thinking skills are influenced by several factors, namely heredity/heredity factors, environmental factors, nutritional factors, and formation factors.

Research Method

The research on the influence of the Based Learning model on the ability to recognize the geometry of group B children in Pembina State Kindergarten was designed using a quantitative approach. This study uses data and results from research in the form of statistical data so that research that is in line with this is quantitative. While the type of design for this study is using experimental research. The design of this study uses *a pretest-posttest control group design*, namely the first group is given treatment (experimental group) of the PBL model while the second class uses conventional methods, namely lectures and questions and answers. Before the research began, the two classes were given *a pretest* and *a post-test. The pretest* is conducted to discover the initial knowledge about the material to be taught. *Post-test* to find out the knowledge mastered by the child after the learning process.

The data collection techniques used in this study are test and non-test techniques. Test techniques are given before *(pretest)* and after treatment *(post-tests). Pretest is a test given before teaching begins and aims to determine* how far students have mastered the teaching material to be taught. *The pretest* aims to find out children's initial knowledge of plant tissue material. *Post-tests* are tests given at the end of each teaching unit program, and the aim is to find out how far students have achieved teaching materials after experiencing a learning activity. Meanwhile, *post-tests* are given to determine the effect of treatment. Non-test techniques in the form of observation are used to assess affective aspects during the learning process in the classroom and the psychomotor realm during the practicum process and discussion in problem solving. Research instruments are tools used to measure research. This study used learning outcome test instruments and learning process observation sheets.

Data collection techniques are needed in research because they can determine the success of a research. The following data collection techniques are used in the form of tests, observations, and documentation. The data collection procedure in this study goes through several stages, namely planning, implementation (pre-test, treatment, post-test). Meanwhile, data analysis was used to analyze the results, namely comparing the results of the experimental group with before and after *the problem-based learning* activities to find out the changes that occurred in the children's geometry concept abilities and also to find out whether the *problem-based learning activities* experienced changes in the children's geometry skills.

Descriptive statistical analysis was used to determine the difference in children's geometry abilities before and after being treated with *problem-based learning activities in Bungoro Coaches Kindergarten*. Furthermore, in order to obtain an overview of the average level of children's geometry ability, it was carried out by calculating the average using the SPSS 24 application, the presentation of the data in the descriptive statistical analysis included calculations to determine the lowest and largest values, mean, median, mode, standard deviation, variance and mean.

Result

The distribution of categorization of the geometry ability of the experimental group that was given the treatment of problem-based *learning* with paper media can be seen in the table.

Table 1. Frequency Distribution of Children's Geometry Ability in the Experimental Group (*Post-Test*)

It	Interval	Category	Frequency	Percentage
1	16-17	Undeveloped	0	0
2	18-19	Start Growing	2	28,58%
3	20-21	Developing as Expected	1	14,28%
4	22-23	Develops Very Well	4	57,14%
		Sum	7	100%

Source: Results of Research Data Processing in Group B of Bungoro Pembina State Kindergarten

Based on the table, it can be seen that in the final test given to the experimental group to determine the children's geometry ability, it was known that out of the number of 7 children who were used as an experimental class, there were no children whose ability to recognize geometry was in the Undeveloped (BB) category with a percentage of 0%. There are 2 children, namely AAK and AN whose ability to recognize geometry begins to develop (MB) with a percentage of 28.58%, seen where children are able to recognize geometric shapes with the help of teachers, children are able to match geometric shapes with the help of teachers, and children are able to group geometric shapes with the help of teachers.

There is 1 child, namely ILM whose ability to recognize geometry is in the category of Developing According to Expectations (BSH) with a percentage of 14.28%, seen where the child is able to recognize geometric shapes without the help of a teacher, the child is able to match geometric shapes without the help of a teacher, and the child is able to group geometric shapes without the help of a teacher. There are 4 AFF children whose ability to recognize geometry is in the Very Good Development (BSB) category with a percentage of 57.14%, seen where the child is able to recognize geometric shapes without the help of the teacher and can help his friends, the child is able to match geometric shapes without the help of the teacher and can help his friends, and the child is able to group geometric shapes without the help of the teacher and can help his friends.

Table 2. Results of the Descriptive Analysis Test of the Experimental Group (Post-Test)

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
VAR00001	7	18.00	23.00	21.0000	2.00000
Valid N (listwise)	7				

Source : SPSS 24 Output

Based on the results of the calculation of descriptive statistical analysis in table 4.6, it appears that from the 7 variable data of the experimental class after being given treatment, it shows a minimum value of 18, a maximum value of 23, an average of 21, and a standard deviation of 2,000. Distribution of categorization of children's geometry abilities that are not given learning treatment Problem Based Learning with paper media can be seen in table 3.

Table 3. Frequency Distribution of Children's Geometry Ability in the Control Group (Post-Test)

It	**Interval**	**Category**	**Frequency**	**Percentage**
1	14-17	Undeveloped	3	42,85%
2	18-19	Start Growing	1	14,28%
3	20-21	Developing as Expected	3	42,25%
4	22-23	Develops Very Well	0	0%
Sum			7	100%

Source : Results of Research Data Processing in Group B of Bungoro Pembina State Kindergarten

Based on the table, it is known that out of the number of 7 children who were used as a control class, there were 3 children, namely NRL, ALM and ALA whose ability to recognize geometry was still in the Undeveloped (BB) category with a percentage of 42.85%, seen where children were not able to recognize geometric shapes, children were not able to match geometric shapes, and children were not able to group geometric shapes. There is 1 child, namely NIM whose ability to recognize geometry is in the category of Beginning to Develop (MB) with a percentage of 14.28%, seen where the child is able to recognize geometric shapes with the help of the teacher, the child is able to match geometric shapes with the help of the teacher, and the child is able to group geometric shapes with the help of the teacher.

There are 3 children of RFH, M.AD and AIN whose geometry ability is in the category of Developing According to Expectations (BSH) with a percentage of 42.85%, seen where the child is able to recognize geometric shapes without the help of the teacher, the child is able to match geometric shapes without the help of the teacher, and the child is able to group geometric shapes without the help of the teacher.

As for the Very Good Development (BSB) category with a percentage of 0%, there are no children in this category, meaning that no child has the ability to recognize geometry to reach this category.

Table 4. Results of the Control Group Descriptive Analysis Test (*Post-Test*)

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
VAR00002	7	14.00	20.00	17.7143	2.42997
Valid N (listwise)	7				

Source : SPSS 24 Output

Based on the results of the calculation of descriptive statistical analysis in table 4.8, it appears that from the 7 variable data of the control class after being given treatment, it shows a minimum value of 14, a maximum value of 20 with an average of 17.71 and a standard deviation of 2.429.

The results of the research obtained from the beginning of observation to the end of observation, it can be said that the learning *probelm based learning* with paper media has an effect on the geometry ability of 5-6 year old children at Pembina Bungoro State Kindergarten after a hypothesis test with test analysis *Wilcoxon* using the SPSS application. Greetings to decision-making if the Sig (2-tailed) value > 0.05, then H1 is accepted and H0 is rejected, meaning learning *Problem Based Learning* through paper play activities did not affect the geometry ability of 5-6 year old children at Pembina Bungoro State Kindergarten. If the Sig (2-tailed) value < 0.05, then H0 is rejected and H1 is accepted, meaning that there is an influence of learning *Problem Based Learning* with paper media on the geometry ability of 5-6 year old children at Pembina Bungoro State Kindergarten.

Discussion

Children's Ability to Know Geometry Before Being Given the Application of Problem-Based Learning

It is known that the children's geometry ability in the experimental group at the time of *pretest* where out of a total of 7 children who were used as an experimental class, there were 2 children who were still in the Undeveloped (BB) category. There are 3 children in the Starting to Develop (MB) category. There are 2 children in the Growing Up to Expectations (BSH) category. As for the Very Well Developed (BSB) category, there are no children in this category, meaning that no child has reached this category with the ability to recognize geometry. Meanwhile, in the control group at the pretest, 3 children are still in the Undeveloped (BB) category. There are 3 children in the Starting to Develop (MB) category. There is 1 child in the Developing According to Expectations (BSH) category. For the category (BSB), 1 child is in the category of 14.29%. children whose ability to recognize geometry reaches this category.

Children's Ability to Know Geometry After Being Given the Application of Problem-Based Learning

It is known that the children's geometry ability in the experimental group during *post-test* where of the 7 children who were used as an experimental class, there were no children whose ability to recognize geometry in the Undeveloped (BB) category. There are 2 children in the Developing Beginning (MB) category. There is 1 child in the Developing According to Expectations (BSH) category. There are 4 children in the Developing According to Expectations (BSB) category. Meanwhile, in the control group, at the time of the post-test, there were 3 children who were still in the Undeveloped (BB) category. There is 1 child in the Starting to Develop (MB) category. There are 3 children in the Growing Up to Expectations (BSH) category. And for the Very Well Developed (BSB) category, there are no children in this category, which means that no child has reached this category whose ability to recognize geometry has reached this category.

Based on the results of the calculations, there was a significant difference in children's geometry abilities in the experimental and control groups. In this case, the average score in the experimental group was higher than the average value of the control group.

The Effect of Problem Based Learning on Children's Ability to Know Geometry

Hypothesis test results with test analysis *Wilcoxon* using SPSS amulification in decision-making if the sig value (2-tailed) > 0.05 then H1 is accepted and H0 means learning *Problem Based Learning* It does not affect the child's geometry ability.

Test analysis results *Wilcoxon* In the experimental group, the treatment given was the value of *Asymp* Sig (2-tailed) obtained 0.017 < 0.05, then H0 is rejected and H1 is accepted, meaning there is an influence of learning *Problem Based Learning* on the child's geometry ability. Meanwhile, in the control group that was not given learning treatment *Problem Based Learning* Through the activity of Asymp Sig (2-tailed) value obtained 0.017 > 0.05, H0 is accepted and H1 is rejected, meaning that there is no influence of geometry poster activities on

children's geometry ability. In this case, the average value of the results of the children's geometry ability score in the experimental group was higher than the average score of the control group.

The results show that the geometry ability in the given group *Treatmen* in the form of learning *Problem Based Learning* through playing activities with media is better compared to the control group that is not given learning treatment *Problem Based Learning* through activities.

Result *Pre-test shows that 50% of children are in the category of not yet* developing, 33% in the category of starting to develop and 17% of children in the category are developing as expected. After making observations in the field, it turned out that the cause of low geometry skills in children was because the learning activities used were conventional in the form of lectures on geometry material so that children showed less interest. Then the researcher applies learning *Problem Based Learning* It is a problem-based activity using media that trains children to solve problems and solve problems in the media by arranging and matching geometric pieces so that they can become a complete picture that is able to practice the ability to recognize geometry in a fun way for children aged 5-6 years. This research involved one kindergarten teacher, *treatment* conducted three times to prove the learning *Problem Based Learning* Through playing with paper media, it can improve the geometry skills of children aged 5-6 years. The results of the study showed that the development of children's geometry increased significantly to 28.58%, which were included in the starting to develop, 14.28% developed as expected and 57.14% included in the category of developing very well. Within 5 days, this study was successful because it could improve the geometry ability of children aged 5-6 years.

This research is in line with the research (Wulandari, et al, 2018) with the title of the article Model *Problem Based Learning* Regarding the Ability to Know the Concept of Numbers in Early Childhood concluded that learning using the *Problem Based Learning* has an influence on the ability to recognize the concept of numbers in early childhood at Aisyiyah Bustanul Athfal Kindergarten Gunung Terang Bandar Lampung. This is proven that the ability to recognize the concept of numbers after using the model *Problem Based Learning* higher than before using the model *Problem Based Learning*. This means that using the model Problem Based Learning In learning can help stimulate children's ability to recognize the concept of numbers.

This research is also supported by (Ningtyas, 2016) with the title of the article The Influence of Media on the Ability to Recognize Geometry Shapes Group B concluded that by using the media, children's ability to recognize geometry increases. So, there is a difference in the ability to recognize geometric shapes from before and after the treatment, the researcher also succeeded in improving the ability to recognize geometric shapes through the media and there is a very strong influence between the use of media and the ability to recognize geometric shapes in group B. So, based on various theories and previous research that supports the success of this research, it can be concluded that *Problem Based Learning* can affect geometry ability in children aged 5-6 years.

Conclusion

Based on the results of the research, the following conclusions can be drawn;

1. The application of *problem-based learning* is carried out for 3 days. It is carried out with steps, namely the researcher prepares geometry learning media then explains the problem (problem) and is asked to solve the problem in the media to the child while the researcher first introduces the names and shapes of geometry, namely triangles, circles, squares and rectangles, problems What the child will complete is that the child is asked to name and name the geometric puzzel. The child is asked to match the geometric pieces so that they become a whole picture and the child is asked to group the image of objects in the form of triangles, circles, squares and rectangles. As for the control group, geometry learning is applied to students using geometric picture posters.
2. Children's geometry skills before being given problem-based learning treatment received an average of 10.54 in the control class and 10.14 in the experimental class. Then the children's geometry skills after being given the treatment of *problem-based learning* with media got an average of 17.71 in the control class and 21.00 in the experimental class.
3. There is a significant influence in the application of *problem-based learning* through paper media play activities on early childhood geometry skills.

Declaration of conflicting interest

The authors declare that there is no conflict of interest in this work.

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