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The Effectiveness of Project-Based Learning on Early Childhood Problem-Solving Skills: An Experimental Study

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Abstract: Problem-solving skills are important to be stimulated early on. Problem-solving skills can be stimulated through project learning activities. This study aims to determine the effectiveness of project-based learning on the problem-solving ability of Group B children at TKIT Salman Al Faris I. This type of research is quantitative, and the research design used is the Group Pretest-Posttest Design, with a population of 45 children and a sample of 20 children. The sampling technique employed was purposive sampling, and data collection methods included tests, documentation, and observation. Data analysis involved testing the research hypothesis using a t-test. The results showed that the project learning treatment was effective in improving problem-solving ability. These results were obtained from the pre-test, which had an average value of 65, and the post-test results after treatment had an average of 106, with a minimum gain of 30 points and a maximum value of 120 points. Then, the results of the project learning on problem-solving ability obtained a significant value of 0.000, which indicates a statistically significant value. 0.000 < 0.05 (2-tailed). Having the ability to solve problems will help children to become quality resources. This research demonstrates that project-based learning is effective in enhancing Group B's problem-solving skills at TKIT Salman Al Faris I.

INTRODUCTION

Early childhood is children aged 0-6 years where at that age the process of child growth and development runs rapidly. From an early age, children's brain growth develops by 80%, while the remaining 20% develops after childhood (Khadijah, 2016). Early childhood is a vulnerable period that has an influence in shaping the quality of children in the future (Hartawan, 2022; Saputra et al., 2023). At that age, children are in a sensitive period where children are able to receive a lot of stimulation to support their growth and development (Febriana Kurniawati et al., 2024). Therefore, early childhood is said to be an essential period because the process of child development at that time cannot be repeated. Children's growth and development needs to be stimulated so that children are able to grow according to developmental milestones. Stimulation for children can be obtained through early childhood education.

Early childhood education is able to provide comprehensive stimulation to develop the abilities of children (Arisadewi et al., 2019). Early childhood education is a process of guidance for children from birth to six years of age, carried out by providing educational

stimulation to support the growth and development both physically and mentally of children so that they are ready to follow the next level of education (Ananta et al., 2023). Through early childhood education, children are able to learn in a fun way and it is easier to receive and understand the material (Swari & Ambara, 2022). So it can be said that early childhood education is an effort to help children grow and develop so that children can develop all the potential that exists in themselves and are ready to enter a higher level of education in the future.

The learning process in ECD stimulates various aspects of child development. Developments such as physical, emotional, social and cognitive are developments that are the focus of stimulation in PAUD to encourage children to think, gain new experiences and knowledge (Dorji et al., 2020). One aspect that is important to develop early is the cognitive aspect. Cognitive is an aspect of development related to the ability to think. The ability to think has a role in determining the effectiveness of children's learning (Aisyah et al., 2024). The development of thinking power, acquisition of information, and children's ability to face various challenges are the focus developed in cognitive aspects (Febriana Kurniawati et al., 2024). The ability to deal with dynamic situations and solve problems is also considered a cognitive aspect (Rahayuningsih et al., 2020). Thus, cognitive aspects play an important role in children's learning process, because through developed thinking skills, children are to understand information, learn more effectively, adapt and overcome problems. The ability to solve problems is part of cognitive development

The ability to solve everyday problems including remembering, paying attention, and reasoning is part of the cognitive aspect (Haoyue & Oyam, 2024). It is stated that being able to solve problems in a structured manner is a further level of cognitive ability (Wang et al., 2015). Problem solving ability is the ability to find solutions through a systematic and measurable way of an everyday problem (Mutoharoh et al., 2021). The ability to solve problems is considered important because it involves the ability to analyze, understand, conclude, estimate, assess, and think again so that a person can find solutions when facing problems (Jacob et al., 2024). So the ability to solve problems is an ability that involves thinking processes such as remembering, paying attention, and reasoning. Because it involves many thinking skills, the ability to solve problems is important to have so that one can find solutions in everyday life.

The problems faced by early childhood are certainly different from the problems faced by adults. Examples of problems that early childhood can face in everyday life include when children accidentally spill water, break an item, want the same item as a friend or get a task from the teacher. It is said to be a problem if someone tries to find a solution but does not understand how to (Nguyen & Nguyen, 2022). To be able to overcome these problems, children need to be encouraged to think in solving problems. Children need to be trained to think of ways, steps or actions to take in solving problems. This will teach children to be more responsible and direct children to find solutions with their own abilities (Ocak et al., 2021).

Solving problems has four stages according to Polya, namely understanding the problem, planning to solve the problem, implementing the plan and looking back at the results obtained in solving the problem (Chumsukon, 2020). To be able to understand the

problem, children can be invited to make observations first, both the environment and the problem at hand. When children make observations, teachers can provide questions or explanations to deepen children's knowledge. After that the teacher can encourage children to plan solutions to existing problems. Through observing, experiencing and understanding the environment and problems, it will form knowledge from within the child (Haenilah et al., 2021). After that, children can be given the opportunity to directly implement the plans that have been made. Given the opportunity to actively explore and try directly from the environment will build children's understanding, including in solving problems (Kurnia et al., 2024) . Finally, looking back at the results obtained in solving the problem, this aims to evaluate the process that has been passed. Can be done by asking children to show and tell their work (Magta et al., 2019). If in this evaluation there is an incorrect understanding or information from the child, the teacher can straighten out the understanding and information. This last stage can also be a place to share information with other children in the class.

Having the ability to solve problems, children will have an independent attitude, never give up, not easily complain and adapt to the environment well. However, in the process it is still found that many children are still unable to solve their own problems and depend on the help of adults or teachers (Kurnia et al., 2024). Initial interviews with teachers found that teachers felt that children were not able to solve their own problems. Children tend to immediately ask the teacher for solutions rather than trying to solve the problem first. Initial observations also found that children have not been able to solve their own problems. When playing and the child is asked what they are playing, the child looks difficult to explain. When asked after this what they wanted to play, the child just shook his head without giving an explanation. This is the background for researchers to deepen the ability to solve problems. Researchers used project learning as a treatment to see if project learning has an effect on children's problem-solving skills. The school has never done project learning for daily learning activities. Project learning is a collaborative learning method that is effective in developing children's abilities. Project learning does not only stimulate one aspect, but can stimulate other aspects of development (Crespí et al., 2022).

Project learning emphasizes a child-centered, hands-on and inquiry-based approach (Misbah et al., 2024) . In contrast to previous studies, researchers take specific project learning according to Katz. Katz et al. (2014) has an opinion that project learning has four stages, namely planning and discussion, expert questions or field studies, implementation, and display and reflection. The difference between Katz's project learning is that in the second stage, if using experts, it is expected to bring in real experts. If using field studies, children must be taken to the environment directly. Then it will be seen how the ability to solve problems after being given the project learning treatment. Given the ability to solve problems is an important ability that needs to be possessed in the 21st century (Chumsukon, 2020). Having the ability to solve problems will shape children into quality human resources in the future. Based on this explanation, researchers will see how project learning influences problem-solving skills and see in detail both the obstacles and advantages of project learning itself being applied and implemented.

METHODS

This study uses a quantitative approach with a type of quasi-experimental research and a one group pretest-posttest design which can be seen in table 1. This study aims to see how the effectiveness of project learning on problem solving skills in group B children at TKIT Salman Al Farisi I. The population in this study was 45 children using 20 children as research subjects. Taking research subjects based on proportionate stratified cluster purposive random sampling technique where stratified refers to a certain level, cluster is a certain area, while purposive refers to certain considerations (Sugiyono, 2021). The criteria are a) kindergarten that has A accreditation, b) has educational services for children aged 5-6 years or group B, c) in the city of Yogyakarta, d) has a specialty in early childhood character development, e) has never used project learning in daily learning, f) has learning facilities that support project learning. The research design used can be seen in Figure 1.

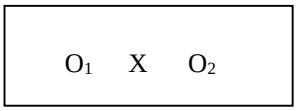

Figure 1. One-Group Pretest-Posttest Research Design (Cohen et al., 2007)

The research was conducted from October to November during 15 effective school days with details of the first day used to carry out the pre-test, thirteen meeting days to implement the project and the last day used to carry out the post-test. Specifically, the project learning treatment during the study started on October 28, 2024 until November 16, 2024. The instrument used a Likert scale to measure each indicator described in the statement items in the problem solving ability questionnaire. The Likert scale can be used to measure a person's behavior, views and understanding (Sugiyono, 2021).

Researchers used four scales for the assessment of problem solving skills in the instrument used. The use of four scales in this instrument has a consideration of bias in the assessment during the research (Joshi et al., 2015; Kusmaryono et al., 2022). In this study, researchers gave a score of 1 if the indicators of problem solving ability and cooperation ability had not developed (BB). Score 2 if the indicators of problem solving ability and cooperation ability are starting to develop (MB). Score 3 if the indicators of problem solving ability and cooperation ability develop as expected (BSH). Score 4 if the indicators of problem solving ability and cooperation ability develop very well (BSH)

Researchers used four indicators of problem solving in this research instrument, namely a) problem understanding skills, b) plan-making skills, c) plan-executing skills, and d) revisiting skills. total items of the four indicators amounted to eight items that were tested for validity and reliability. Validity and reliability tests are carried out to ensure that the instrument can be used to measure what will be measured (Sugiyono, 2021). Researchers conducted validity and reliability tests on the instruments with the aim of ensuring that the instruments used can measure appropriate problem-solving skills and have significant accuracy, so that the research process carried out can produce quality research data.. A good research process certainly requires a good validity concept as well. Each validity question will be able to describe the research that will be expected to the maximum. In this study, the results of the validity test can be seen in table 1.

Table 1. Results of the Validity Test of Problem Solving Ability Items

	Corrected item-total correlation	r-table	Conclusion
Item 1	.819	.349	Valid
Item 2	.843	.349	Valid
Item 3	.502	.349	Valid
Item 4	.481	.349	Valid
Item 5	.551	.349	Valid
Item 6	.678	.349	Valid

The analysis results process that has been carried out and can be observed in Table 1 shows the results of the validity test and provides an illustration that the six problem-solving ability items are declared valid.. To see whether the items used are valid, you can compare the value in the *corrected item-total* section with the r-table value which can be seen in the t-table formula (Sugiyono, 2021). In this study, the minimum r-table limit used was 0.35 which was adjusted to the number of respondents in the validity test. The number of items used in this study were six items with a minimum value obtained by respondents of 30 points and a maximum value obtained of 120 with the formula for the total number of values obtained divided by the research respondents used multiplied by one hundred percent. The data from the analysis of the Reliability Test Results of Problem Solving Ability Questions can be seen in Table 2.

Table 2. Results of Reliability Test of Problem Solving Ability Items

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.808	.824	8

Table 2 is a reliability test where the reliability test results show that the problem solving ability item has a *Cronbach's Alpha Based On Standardized* value of 0.82 where these results are declared reliable. The limit value of the instrument using *Cronbach's Alpha* analysis is declared reliable if the value obtained is between 0.7 to 0.8 (Yun et al., 2023). The results of the validity and reliability tests tested by researchers were declared eligible so that the instruments used by researchers could be used in research. Strengthened by the existence of expert validation or expert judgment, in this case the researcher uses two experts, namely lecturers who concentrate on the field of cognitive abilities and project learning. Expert validation is tasked with providing evaluation and input on the content of the instruments used (Adillah et al., 2022).

Data collection techniques using observation and documentation using instruments based on expert theory which are then tested for validity and reliability using SPSS. The data analysis method used is statistical testing with the stages of data collection, data processing, data analysis, data presentation, discussion and conclusion drawing. Through this study, the researcher hopes to be a reference for readers, schools, and the wider community and a new view related to problem-solving skills and project learning. Researchers believe that developing problem-solving skills from an early age will produce a golden generation in the future and of course the results of this study can be one of the supporters to realize a golden Indonesia in 2045.

RESULTS AND DISCUSSION

The research was conducted during 15 effective school days where on the first day the researchers conducted a pre-test of 20 children, then on the second day to the fourteenth day the researchers provided project learning treatment and on the fifteenth day the researchers conducted a post-test. This aims to find out how effective project learning is on the problem-solving ability of group B children. Researchers believe that problem-solving ability is an ability that needs to be stimulated as early as possible. The ability to solve problems will help children later in determining solutions when facing a problem.

Instrument and Prerequisite Test Results

To find out whether the results of the analysis obtained during the study are valid, it is necessary to conduct two prerequisite tests, namely the normality test and the homogeneity test. The normality test is carried out to ensure that the data obtained is normal or not. While the homogeneity test is carried out to ensure that the data obtained is homogeneous in its data variation. The results of the normality test in this study are clearly depicted and can be seen in Table 3.

Table 3. Normality Test

Class		Shapiro-Wilk		
		Statistics	df	Sig.
Results	Pre	.097	20	.062
	post	.930	20	.151

Based on the results obtained in table 3, it can be seen that the results of the normality test during the pre-test using the Shapiro-Wilk test obtained a significance value of 0.062 while the results of the normality test during the post-test using the Shapiro-Wilk test obtained a significance value of 0.151. To be able to say that the data is normal can be seen from the significance value obtained. If the significance value obtained is greater than 0.05 with a significance level of 5% so that the data is said to be normal (Mishra et al., 2019). So the normality test on both the pre-test and post-test is said to be normal because the value obtained is more than 0.05. The Homogeneity Test value for TKIT Salman Al Farisi I can be seen and observed in detail in Table 4.

Table 4. Homogeneity Test Homogeneity Test TKIT Salman Al Farisi I

		Levane Statistics	Sig.
Results	**Based on the average**		
		2.987	0.92

The results in table 4 show that the homogeneity test obtained a Levene statistic of 2,987 with a significance value of 0.92. To say that the data is homogeneous, the significance value must be greater than 0.05 with a significance level of 5% so that the data can be said to be homogeneous (Chukwudi et al., 2019). This normality and homogeneity test needs to be done as a requirement before conducting parametric tests and t-tests. in this study, In this study, the normality and homogeneity tests conducted have met the requirements for making research decisions.

Description of Pre-test and Post-test Data of Problem Solving Ability

The research was conducted by giving a pre-test related to problem solving ability first, then continued with the provision of project learning treatment and ended with giving a post-test to measure problem solving ability. Problem solving ability is observed continuously by the researcher with the help of the teacher. At the time of assessment, the researcher will ask for help from the teacher to be involved in taking scores so that the results of the scores obtained are the result of joint discussion between the researcher and the teacher. The instruments used in the pre-test and post-test are no different. Keep in mind that the minimum score that respondents can get is 30 points and the maximum score that respondents can get is 120 points. Problem solving skills need to be honed until children get used to finding solutions to problems independently.

Table 5. **Data on Problem Solving Ability Data on Problem Solving Ability**

Data	N	Min	Max	Mean	Std.Deviation
Pre-test	20	45	85	65	13.860
Post-test	20	85	120	106	10.712

Table 5 shows the data obtained during the pre-test and post-test of problem solving skills conducted on 20 children as respondents. The results of the pre-test of problem solving ability show that the lowest score obtained by the child is 45, the highest score successfully obtained by the child is 85, the average value (*mean*) 65 and the standard deviation value 13.860. For the post-test results, the lowest score obtained by the child was 85, the highest score obtained by the child was 120, the average value (*mean*) was 106 and the standard deviation value was 10.712.

On the pre-test assessment on the first day, the results showed that 5 children (25%) scored between 40-49, 4 children (20%) scored between 50-59, 4 children (20%) scored between 60-69, 2 children (10%) scored between 70-79, and 5 children (25%) scored between 80-89. While in the post-test assessment, the results showed that 3 children (15%) scored between 85-92, 4 children (20%) scored between 93-100, 4 children (20%) scored between 101-108, 6 children (30%) scored between 109-116 and 3 children (15%) scored between 117-120. The results of the pre-test and post-test illustrate that there is an increase in the ability to solve problems from before being given treatment and after being given project learning treatment. The average value obtained during the post-test is higher than the average value during the pre-test. Then the minimum and maximum values during the post-test are also far from the pre-test values.

The Impact of Project Learning on Problem Solving Skills

The findings obtained from the pre-test and post-test assessments carried out previously, then hypothesis testing is carried out as a further step whose purpose is to see how effective the use of project learning is on the ability to solve problems in group B children at TKIT Salman Al Farisi I. Project learning is considered as learning that is able to provide new experiences and understanding in a fun way. Project learning is also designed to provide deep understanding, stimulate children's critical thinking and collaboration (Santhosh et al., 2023). In addition, project learning is also able to encourage

children to know problems directly and find solutions (Kusadi et al., 2020). For this reason, researchers want to see how much effectiveness project learning has on problem solving skills. The hypothesis is that there is an effectiveness of project learning to improve the ability to solve problems in group B children (Ha) and there is no effectiveness of project learning on the ability to solve problems in group B children (H0).

Table 6: Project Learning Data on Problem Solving Ability

Variables	Data	t	Sig (*2-tailed*)	Category
Problem Solving Ability	Pretest-Posttest	19.156	0.000	Impact

Based on Table 6, the paired group t-test results with a significance level of 5% show a significant value of 0.000 from the pre-test and post-test results. Data is considered to have an influence if the sig value. 0.000 < 0.05 (2-tailed). These results indicate a significant effective impact, where project learning provides an increase in children's problem solving skills, so the hypothesis Ha is accepted and H0 is rejected. If the result of paired group t-test exceeds 0.05 then project learning is considered to have no influence or effect on children's problem solving ability.

Problem solving ability is believed to be an ability that will help a person face obstacles and increase success in the community environment (Özreçberoğlu & Çağanağa, 2018). Solving problems provides children with understanding through observing activities, thinking about the problem which is then analyzed how to solve it. Children need to collect information from various sources, then understand the information according to their needs, analyze and produce solutions (Anggereini et al., 2023). Saying that solving problems involves many thinking developments such as analyzing, understanding, estimating, and assessing in finding solutions (Jacob et al., 2024). Seen further, the effect of project learning on the ability to solve problems is because project learning gives children freedom to learn according to their interests.

Learning activities that provide opportunities for children to explore will stimulate various aspects, one of which is the ability to solve problems. Project learning conducted by researchers refers to the project owned by Katz et al., (2014) which has four stages starting from the first stage, namely planning and discussion. In the first stage, the topic is determined together with the child to be studied and develop questions that will be sought for answers. The topic used in project learning can be determined by the teacher or school before it is offered to the children. Although it is child-centered, the teacher still needs a plan if there is no topic proposal from the child at the discussion stage. A good topic for learning is the topic that is closest to the child. In this study, the researcher used three topics: environmental hygiene, self-examination and protection and my favorite animal.

If the topics discussed are topics that are close to the child, the child is more likely to know concretely. A good topic is one that is child-centered, allows children to explore the world, matches children's interests and is close to the real world (Akyol et al., 2022). In project learning, the teacher's knowledge of the topic also determines how deeply the topic can be discussed. The teacher's understanding will also determine the course of the discussion that occurs in this first stage so that it can provide an overview both for the

teacher about the child's initial understanding and for the child himself. The activity of determining the topic and discussion can be seen in Figure 2.

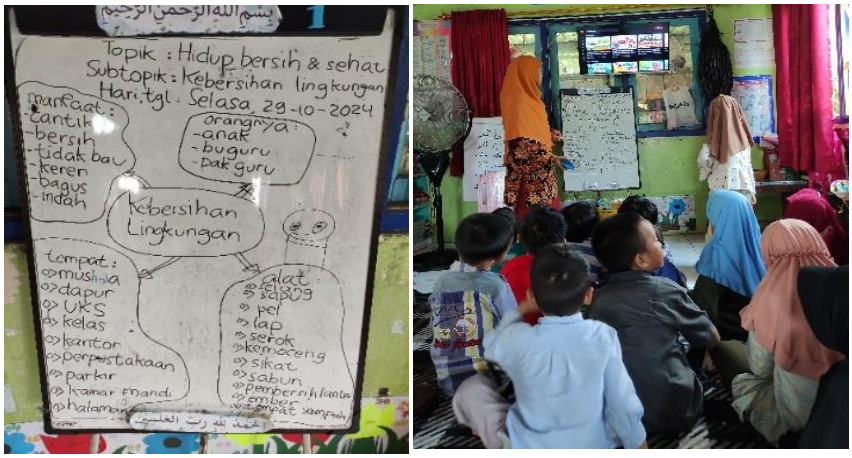

Figure 2. Concept map on the topic of Environmental Hygiene

The second stage is by asking experts or by conducting field studies. Katz et al. (2014) said that the stage of asking experts is to provide information through two sources, primary sources and secondary sources. Primary sources are bringing in experts in their fields or taking children to places related to the topic directly, while secondary sources are through photos, videos, pictures, books and so on according to the topic discussed. During the research process, the researcher tried to provide primary sources for the children. Although also elaborated with secondary sources. Through experts or direct field studies, children are able to obtain concrete learning. Concrete learning will be useful for children to expand and understand information (Baroody, 2017). The experts used were an expert in the field of hygiene who is a janitor from the school for the topic of environmental hygiene and an expert in the field of child psychology who is one of the guardians of students at the school for the topic of self-examination and protection. Bringing in experts does not always have to be from outside the school environment, which is expensive. Teachers in coordination with the school can involve stakeholders such as school-owned education personnel or parents to become expert resource persons. Similarly, with field trips, teachers can utilize the surrounding environment as a concrete place for children to gain direct and concrete experience for children as was done during the research.

Figure 3. Teacher Learning Activities in Attracting Student Interest

Figure 3 shows the second phase of the activity where children are invited to walk around the school environment and given the opportunity to get hands-on experience and be explained directly by the education personnel responsible for maintaining school cleanliness. Children are given the opportunity to have direct dialogue and try to clean the environment with the tools demonstrated. Then children are also given the opportunity to dialogue and listen to explanations from parents of students who have a profession as a psychologist who is active in the field of child protection when the topic of self-examination and protection. Physical activities such as exploration and psychic can be a stimulation to develop children's knowledge, understanding and skills to deal with changing situations (Kurnia et al., 2024).

The third stage is doing the project. At this stage the teacher prepares tools and materials for project activities according to the topic discussed and acts as a driver of children's abilities such as observation skills, observation skills, communication skills and the ability of child development aspects. At this stage the teacher is not too much directly involved with the project that the child is working on. The teacher has a key role as a facilitator (González & León, 2020). Teachers are expected to encourage children to explore and try new things as a means of fulfilling their needs (Amalia, 2023). Children are free to explore the environment, tools and materials available. Then children can conduct experiments to find answers to questions that have been discussed in the first stage independently or in groups. The project activity can be seen in Figure 4 below.

Figure 4. Project Implementation

The third stage of project learning was conducted by the researcher on the third to fifth day of the learning week. In Figure 4, children created projects based on the topics of environmental hygiene, personal examination and protection, and my favorite animal according to the information they got in the previous stage. Some children made a classroom, TU room with the topic of environmental hygiene. Then there are those who make parks, markets, roads as places that need to pay attention to personal inspection and protection and make star gardens, sometimes animals on the topic of my favorite animals. The learning process must provide space for children to complete tasks independently so that they can feel valuable knowledge and experience (Kurnia et al., 2024). Recognizing situations, finding problems, understanding appropriate concepts, then determining and

carrying out the right way to solve them is a process in problem solving (Anggereini et al., 2023).

The fourth stage is display and reflection. This stage is carried out according to mutual agreement in completing the project. At this stage children will be asked to show the results of the work and present or tell the process and results of the work made. This aims as a reflection to see how children retell experiences, prior knowledge, questions, findings, and explanations according to the experiences they have had. The reflection results can also be used as an evaluation during the project learning process to see if the desired goals have been achieved (Crespí et al., 2022). Teachers are also required to provide feedback such as reinforcement on the process during project learning and during the one-day activities that children have done.

The effectiveness of project learning on problem solving skills is supported by research which states that there is a significant effect of the scientific approach on problem solving skills (Erma et al., 2018) . The results of this study also found that there was an increase in the value of problem solving skills after using project learning. The *paired group t-test* test shows a significant value of 0.000 which means that there is a significant effect. Reinforced by the opinion of Akyol et al., (2022)which states that project learning can stimulate various abilities including problem solving skills. The results of this study can also be a reference or reference for teachers and readers who want to do project learning, especially references to project learning according to Katz. Later if the ability to solve problems can be trained early on, it will give birth to a golden generation of qualified successors and be able to compete with global resources.

CONCLUSIONS

This study demonstrates the effectiveness of project-based learning in enhancing problem-solving skills among Group B children at TKIT Salman Al Farisi I. The research, conducted with a population of 45 children and a sample of 20 students, revealed significant improvements in problem-solving abilities following project-based learning interventions. The average pre-test score of 65 points increased substantially to 106 points in the post-test, indicating a strong positive impact of this learning approach. Statistical analysis using paired sample t-test confirmed these findings, yielding a significance value of 0.000 ($p < 0.05$), which led to the acceptance of the alternative hypothesis (Ha) that project-based learning effectively enhances children's problem-solving skills. These results support existing literature on the benefits of active learning methodologies in early childhood education. However, to further validate and expand upon these findings, future research should consider larger and more diverse samples, examine additional variables influenced by project-based learning, and employ alternative research designs such as longitudinal or mixed-methods approaches. Such investigations would provide deeper insights into the long-term effects and broader applications of project-based learning in early childhood education. This study contributes to the growing body of evidence supporting innovative teaching methods and suggests promising directions for future educational research and practice.

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