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The effect of project-based learning model on students' IPAS learning creativity

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Abstract: This study aims to determine the effect of the project-based learning model (PjBL) on the learning creativity of fifth-grade science students in elementary school. This study uses a quantitative approach with a quasi-experimental design method and nonequivalent control group design. The research sample consisted of 46 fifth-grade students of SD Negeri 18 Pontianak Timur, divided into an experimental class (23 students) and a control class (23 students). The data collection technique was carried out using tests with pre-test and post-test instruments. Data were analyzed using descriptive statistics and independent t-tests after fulfilling the prerequisite tests for normality and homogeneity. The results showed a significant difference between the experimental and control groups with a p value <0.05. The average posttest of the experimental group (82.61) was higher than the control group (55.24). Analysis per indicator showed that the experimental group excelled in all aspects of fluency (68.50% vs. 64.12%), flexibility (81.52% vs. 38.59%), originality (89.14% vs. 52.72%), and elaboration (89.12% vs. 85.87%). This study proves that the PjBL model has a positive and significant effect on the creativity of fifth-grade students in learning science, so it can be used as an innovative learning alternative to support the development of 21st-century skills in the context of the Independent Curriculum.

Keywords: Effect, Project Based Learning, Creativity, IPAS, Elementary School

INTRODUCTION

Quality education will produce high quality human resources (Suryadi et al., 2024), this requires the education system to not only focus on knowledge transfer, but also the development of 21st century skills that include critical thinking, collaboration, communication, and creativity. it is necessary for a teacher to plan goals and create a learning environment because it supports learners in developing their various potentials (Mardhiyah et al., 2021). These educational goals can only be realised if teachers develop suitable learning models to be applied in teaching and learning activities at school (Mukarromah & Andriana, 2022).

IPAS learning in primary schools has a strategic role in developing students' understanding of natural and social phenomena that occur in the surrounding environment

(Suhelayanti et al., 2023). In grade V primary school students, IPAS learning is expected to not only provide conceptual knowledge (T. W. Handayani, 2018), but also develop students' critical thinking skills, problem solving, and creativity (Trimawati et al., 2020) in facing various challenges in the 21st century (Mulyono & Wekke, 2018).

Creativity is one of the essential skills that need to be developed in primary school students (Z. R. Sitepu, 2025). Another opinion states that creativity includes the ability to generate new, unique, and useful ideas (Rahman, 2022; Saputra, 2018). In the context of IPAS learning, learning creativity can also be defined as the ability of students to generate new ideas, ask investigative questions, design simple experiments, and find innovative solutions to problems related to natural and social phenomena (Sternberg, 2021). It needs indicators that can be used to measure the level of student creativity in improving learning creativity (Dinantika et al., 2019; Natty et al., 2019). The measurement of creativity in this study refers to the creativity indicators developed by Guilford, namely: (1) Fluency is a student's independent skill to generate multiple ideas. (2) Flexibility is the ability of students to propose different solutions or approaches to a problem at hand. (3) Originality is the ability of students to produce various original ideas on their own thinking and does not change the meaning that has been known before. (4) Elaboration is the ability of students to reconsider a problem they face based on a different point of view from what has been widely known before (Nugraha et al., 2018). Therefore, creativity is considered an important skill in the curriculum.

However, reality in the field shows that IPAS learning still faces various challenges, IPAS learning is still mostly carried out with conventional approaches that tend to be instructor-focused approach (Anggraini & Puspita, 2024; Primayana et al., 2019), prioritize the memorization of principles, and allocate less room for students to develop creativity and problem solving skills. This is in line with research findings that reveal that science learning in various schools still tends to be theoretical and less contextualised with students' daily lives (Acim et al., 2024). This condition causes IPAS learning to be less meaningful and not contextualised with students' daily lives (Arisandi, 2024).

When choosing a teaching method, teachers must consider several important things. First, the curriculum used in schools teaching methods are chosen based on it. Second, teachers must pay attention to the characteristics of the students to determine the suitable pedagogical approach. Finally, the selected learning model must possess the following qualities to make students actively involved in the learning process, not just sitting quietly listening. That way, students not only understand the current subject matter, but can also develop abilities and skills that will be useful for their future (Darmisih et al., 2023). Based on the features of the Merdeka Curriculum, as it is put into practice in Indonesia, one of the efforts in supporting the recovery of the Merdeka Curriculum is to improve the learning process learning is through project-based learning (Cholilah et al., 2023), which aims to improve children's creativity, skills, and character building in accordance with the profile of Pancasila students (Barlian & Solekah, 2022). PjBL is learning that involves students in learning activities both in solving a problem and providing opportunities for students to express their creativity more so that it can improve learning outcomes and student creativity (Adnyawati, 2011). When implemented, this model provides students with ample opportunities to make conscious decisions about topic selection, conduct research, and complete specific projects (L. Handayani, 2022; Nikolaos et al., 2024). The PjBL model has syntax that can support

21st century skills, namely determining fundamental questions, designing project plans, developing timelines, monitoring, testing results and evaluating experiences (Ardiansyah et al., 2020). PjBL engages students in a process of inquiry guided by driving questions (Rahman, 2022), which directs students to seek answers through various sources and produce products that reflect their understanding.

Various studies have shown the effectiveness of PjBL models in improving various aspects of learning, such as learning motivation (Ma'wa et al., 2022), critical thinking skills (Rafik et al., 2022), and collaboration skills (Fatiati, 2023). The application of PjBL in science learning in elementary schools can increase students' creativity, which is indicated by an increase in students' ability to generate new ideas, ask investigative questions, and design unique solutions to problems encountered (Safitri & Wulandari, 2023). Although there are many studies on PjBL and creativity, they are generally conducted in the form of Classroom Action Research (PTK) which focuses only on improving learning in a particular class, so the external validity is still limited (Haerullah & Hasan, 2021).PjBL is considered as one of the potential alternatives to overcome these problems (Rifa'i & Utomo, 2024), PjBL is project learning that supports learners to engage in problem-solving investigative activities to produce a product (Dinantika et al., 2019).

Based on this background, this study aims to test the effects of an experiment of the PjBL learning model for IPAS learning and creativity in Class V at SDN 18 East Pontianak. The study's findings are anticipated to be significant the development of effective learning strategies to boost elementary school students' creativity is essential of the Merdeka Curriculum. Through the use of the PjBL model, it is expected that students can be more creative, this is supported by several previous studies, namely by applying the The PjBL model is proven to improve IPAS learning outcomes and creativity of 5th grade students. (Agustin et al., 2023; Khofifah et al., 2023; L. Handayani, 2022; Nugraha et al., 2018; Surya et al., 2018), students not only gain knowledge, but also develop higher-order thinking skills, collaboration, communication, and creativity (Habibunnisa et al., 2024). Therefore, the implementation of a project-based learning model can be considered an effective learning strategy to support the development of creative thinking skills in elementary school students, as required by the Independent Curriculum.

METHODS

The present study employs a quasi-experimental model of quantitative research. This method was chosen because researchers cannot fully control the conduct of the experiment is affected by external variables (Syahrizal & Jailani, 2023). Type of research design nonequivalent control group design, by giving a pretest and posttest, where there is no treatment in the control group and there is treatment in the experimental group.

Table 1. *Desain* Nonequivalent *Control Group Design (*Sugiyono, 2016).

Grup	Pre-Exam	Treatment	Post-Exam
Experiment	O_1	X	O_2
Control	O_3	-	O_4

O_1 = Pretest of experimental group
O_2 = Posttest kelompok eksperimen
O_3 = Pretest control group
O_4 = Posttest control group
X = Treatment in the form of Project Based Learning (PjBL) learning model

The research was conducted at SDN 18 East Pontianak, because student learning creativity was not yet optimal, the research was conducted in semester II of the 2023/2024 academic year. Population is the overall research subject that has certain characteristics set by researchers to study (Asrulla et al., 2023). 23 students of class VA as experimental group and 23 students of class VB as control group. This study uses conventional learning for the control group and pjbl for the experimental group as the independent variable, while IPAS learning creativity as the dependent variable measured through a test.

The research sample was determined through purposive sampling (Wahab, 2022). This technique was chosen because researchers considered the characteristics of students in classes VA and VB who had relatively equal academic abilities based on the class average in the previous semester.

The instruments in this study used teaching modules that had been validated by experts, Learner Worksheets (LKPD) as an introduction to the PjBL learning model, creativity assessment rubrics that measure: (a) fluency; (b) flexibility; (c) originality; (d) elaboration, pre-test and post-test.

Data were analyzed using validity, reliability, normality, homogeneity, and hypothesis testing.(Saputro & Rahayu, 2020). Validity and reliability tests were conducted to determine whether the research instrument was sound and feasible. The validity test was conducted using the Gregory formula. The reliability test used the product-moment correlation formula. Normality and homegenity tests as a prerequisite test for conducting hypothesis testing. The average difference in students' creative thinking between the control and experimental groups is known through hypothesis testing.

Pretest is useful to measure the initial ability of students given before treatment while the posttests are used to measure the ability of students given after treatment (Yulianti et al., 2022). Pretest and posttest data were analysed using descriptive statistics (mean, standard deviation) and significant differences are seen through the t test. Standard deviation is the distribution of data against the average in statistics or the degree of variation of data (Hamidi et al., 2024; Rahman et al., 2024).

RESULTS AND DISCUSSION

Result

The data on the Table 2 shows that there is a difference in creative thinking skills between students who are taught conventionally with project learning.

Table 2. Control and Experimental Group Pre-test and Post-test Results.

Group	N	Pretest Average	SD Pretest	Posttest Average	SD Posttest
Experiment	23	65,10	7,50	82,61	6,75
Control	23	64,80	7,80	55,24	7,10

Based on the Table 2, the pretest results of the control group were 64.80 and the experiment was 65.10 and the standard deviation of the control group was 7.80 and the experiment was 7.50. This shows that the initial ability of students' creative thinking has no difference before being given treatment. The posttest score increased to 82.61 after the application of the PjBL model so that the standard deviation was 6.75. While the posttest value increased to 55.24 after using conventional learning so that the standard deviation was 7.10. Simply put, the increase in the experimental group was higher than the control group.

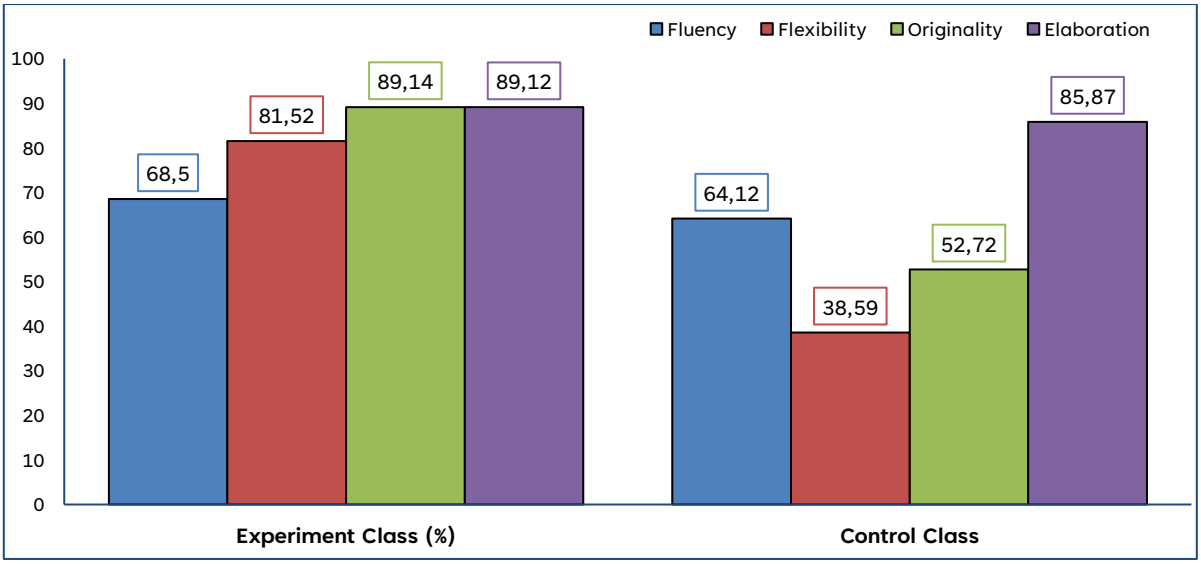

Figure 1. Percentage score on each indicator of creative thinking ability in both groups

The Figure 1 states that the percentage of the experimental group is higher than the control group seen through the indicators of creative thinking. That PjBL is a very effective model to improve students' flexible thinking skills and original thinking skills seen from the increase in flexibility results by 42.93% and originality by 36.42%.

Whether the data is normally distributed or not can be known through the normality test. The Table 3 are the results of the pretest data normality test:

Table 3. Pretest Data Normality Test Results

Group	N	Statistics Shapiro-Wilk	Df	p-value	Conclusion
Experiment	23	0.951	23	0.315	Normal
Control	23	0.946	23	0.257	Normal

Experimental group: p-value = 0.315 > 0.05, so the data is normally distributed and control group: p-value = 0.257 > 0.05, so the pretest data is also normally distributed. Posttest Data Normality Test can be seen in Table 4.

Table 4. Posttest Data Normality Test Results

Group	N	Statistics Shapiro-Wilk	Df	p-value	Conclusion
Experiment	23	0.961	23	0.476	Normal
Control	23	0.953	23	0.334	Normal

Table 5. Data Normality Test per Indicator

Indicators	Group	Shapiro-Wilk	p-value	Status
Fluency	Experiment	0,948	0,281	Normal
	Control	0,944	0,238	Normal
Flexibility	Experiment	0,956	0,378	Normal
	Control	0,934	0,143	Normal
Originality	Experiment	0,963	0,513	Normal
	Control	0,941	0,201	Normal
Elaboration	Experiment	0,958	0,412	Normal
	Control	0,967	0,589	Normal

Experimental group: p-value = 0.476 > 0.05, so the posttest data is normally distributed control group: p-value = 0.334 > 0.05, so the posttest data is normally distributed. Normality Test per Creativity Indicator can be seen in Table 5.

An independent t-test was conducted to test the difference in mean posttest scores between the two groups. The t-test results are presented in Table 6.

Table 6. T-test Results

Statistical Test	t-count	Df	p-value	Conclusion
Posttest t-test	7,23	44	0,000	Significant (p<0,05)

The independent t-test results show a significant value (p-value) of 0.000 (<0.05), statistically there is a difference in mean scores between the two groups in terms of creative thinking ability. The conclusion is that students' creative thinking skills are strongly influenced by the pjbl model.

Discussion

The results showed that the experimental group achieved a score of 68.50%, higher than the control group, which only achieved 64.12%. This difference can be explained by the Project-Based Learning (PjBL) syntax, which requires students to be actively involved in every stage of learning, from defining fundamental questions and project planning to data collection and presentation of results. This active involvement theoretically fosters thinking because students are empowered to address contextual problems that require them to explore various alternative solutions. In classroom implementation, the teacher facilitated small group discussions to formulate project questions, allowing students to adapt their perspectives and negotiate ideas. This enabled divergent thinking, ultimately enhancing their ability to develop unique skills. In contrast, in the control group, learning still focused on individual problem-solving under teacher guidance, resulting in relatively limited opportunities to explore various alternative answers.

To ensure that the data meets the basic assumptions of using parametric statistics, a normality prerequisite test is performed. The normality test using the Shapiro-Wilk method was chosen due to the relatively small sample size (n = 23 for each group) and the high sensitivity of this method in in small samples appear to deviate from the normal distribution. The results of the normality test showed that all the study data were normally distributed, as indicated by p-values that were consistently greater than $\alpha = 0.05$ in all tests. The experimental group pretest data showed a Shapiro-Wilk statistic of 0.951 with a p-value = 0.315, while the control group obtained a value of 0.946 with a p-value = 0.257, This shows a normal distribution, which strengthens the argument for the homogeneity of students' initial abilities. The posttest data also showed normal distribution with an increase in the value of the Shapiro-Wilk statistic in the experimental group to 0.961 (p-value = 0.476) and the control group 0.953 (p-value = 0.334), which reinforces the argument of homogeneity of students' initial ability This indicates that the PjBL model not only improves creativity ability but also produces an even distribution of improvement across different ability levels.

Analysis of distribution characteristics showed that the experimental group had a mean = 82.61 with a standard deviation = 6.75, while the control group had a mean = 55.24 with a standard deviation = 7.10, where a significant difference in mean with a relatively similar standard deviation indicates a consistent increase in creativity ability without producing excessive homogenisation. The normality test per creativity indicator also showed normal distribution in all aspects (fluency, flexibility, originality, and elaboration) with p-values ranging from 0.143 to 0.589, confirming that creativity improvement occurred comprehensively in all dimensions of creativity. The fulfilment

of the normality assumption on all aspects of the research data has significant methodological implications, namely allowing the use of more powerful parametric statistics such as the independent t-test, increasing the external validity of the research because the sample is representative of the population, allowing accurate and reliable interpretation of the results, and providing high confidence for the generalisation of the research results. The normality of the data provides a strong foundation for further statistical analyses including homogeneity tests and main hypothesis testing, so that the research findings have high scientific validity and can be used as the basis for practical recommendation.

The results showed that there was an influence on student learning creativity by using the PjBL model in sdn 18 pontianak timur. This is evident from the experimental group's significance value of less than 0.05 (p-value < 0.05). This is certainly reinforced by the experimental group's average post-test score of 82.61, which is higher than the control group's score of 55.24. This finding is in line with research showing that the application of the PjBL model can improve creativity and science learning outcomes in grade 5 elementary school students with an average increase from 71.5 to 84. 2 (Nugraha et al., 2018). Similar research shows that the PjBL model on student creativity shows a sig. value of 0.000 <0.05, then Ha is accepted so it can be concluded that there is an influence on student creativity by using the PjBL model SDN 03 Kemijen Semarang class V (Damayanti, 2024).

The PjBL model encourages students to be active in the learning process through project work that demands innovation and creativity (Ramadhan & Hindun, 2023). It is expected that this activity can improve creative thinking skills such as fluency, flexibility, originality, and elaboration optimally. While the control group that used conventional learning was less creative and tended to be passive, so that the increase in creative thinking skills is relatively low (A. S. M. B. Sitepu, 2019).

The results showed that the experimental group obtained a percentage of 68.50% on the fluency indicator, while the control group was only 64.12%. Although the difference is not too big, it shows that the PjBL model can facilitate students to generate more ideas in a certain time. Fluency is the ability to generate many ideas that are relevant to the problem at hand (Fakhirah et al., 2023). Similar research supports this finding by showing that students following PjBL learning were able to generate an average of 12 different ideas in one learning session, compared to 8 ideas in conventional learning (Sistia, 2023). This occurs due to the characteristics of PjBL that encourage students to actively seek solutions from various perspectives (Azizah, 2022).

The flexibility indicator reveale the most striking difference between the two groups, with the experimental group reaching 81.52% while the control group was only 38.59%. This significant difference shows that the PjBL model is very effective in developing students' fflexible thinking skills. Flexibility is the ability to change the direction of thinking and produce a variety of approaches to a problem (Firdaus et al., 2018). In the implementation of PjBL, students are faced with obstacles and various challenges during project work that require them to find alternative solutions. Another study showed that students who participated in PjBL learning were able to show an average of 5.7 different approaches in solving one IPAS problem, while students in conventional learning only showed 2.1 approaches (Safitri & Wulandari, 2023).

In the original indicator, the experimental class achieved the highest percentage of 89.14% compared to the control group which was only 52.72%. This shows that the PjBL model is very effective in developing students' ability to generate original and unique

ideas. Originality is an important part of creativity to create something unusual and new (Nugroho et al., 2019). The characteristics of PjBL that give students the freedom to design and develop projects according to their interests and learning styles allow original ideas to emerge (Ramadhan & Hindun, 2023). Another study showed that 78% of students who participated in PjBL learning were able to produce products that were unique and different from their peers, while in conventional learning only 23% of students were able to do so (Dinantika et al., 2019).

While on the indicator description, both groups showed a percentage is relatively high with the experimental group 89.12% and the control group 85.87%. This shows that elaboration skills can be developed through various learning approaches. However, the experimental group still showed which is better. The high elaboration ability in both groups can be explained due to the characteristics of IPAS learning which indeed requires students to provide detailed explanations of the observed phenomena. Other research shows that IPAS learning naturally trains students' elaboration skills through observation and analysis activities (Putra, 2017).

The creativity process in PjBL is categorized as very good. Indicators of student creativity consist of originality, flexibility, fluency, and elaboration in the good category. So it can be concluded that through project-based learning students are able to develop their creativity in make creative works (Sari et al., 2024). So PjBL model is proven to be effective in improving students' creative thinking skills and can be used as an alternative learning model that is more innovative and in accordance with 21st century learning needs.

CONCLUSIONS

Based on the research results, the Project-Based Learning (PjBL) model had a positive and significant effect on the learning creativity of fifth-grade science students at SD Negeri 18 Pontianak Timur. This was evidenced by the results of an independent t-test, which showed a significance value of $p = 0.000 < 0.05$, indicating a significant difference in creativity abilities in the experimental group compared to the control group. The increase in student creativity was evident in the average post-test score of 82.61 for the experimental group, significantly higher than the 55.24 for the control group, representing an increase of 27.37 points.

A thorough analysis of the four Guilford creativity indicators showed that the PjBL model was effective in developing all aspects of student creativity. The flexibility and originality indicators showed the most striking differences, with scores of 81.52% versus 38.59% and 89.14% versus 52.72%, respectively, between the experimental and control groups. Thus, the PjBL model has proven to be an innovative and effective learning alternative for developing the 21st generation to face future challenges, particularly those requiring skills, especially creativity.

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