

Effect of Project-Based Learning (PjBL) on Students' Creative Thinking in IPAS Education

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ABSTRACT

Students' creative thinking is essential for 21st-century education, particularly in science (IPAS). This research seeks to ascertain how implementing the PjBL (project-based learning) approach improves pupils' creative thinking in science learning. This study is a quasi-experimental study with a quantitative approach. A quasi-experimental pretest-posttest control group design with 44 fourth-grade students was used. The sample consists of fourth-grade students at SDN Gunung Gede Elementary School in Bogor City, specifically Class IV B and Class IV C, with 44 students, using non-probability sampling (saturation sampling). Data collection in this research employs tests, observations, and documentation. Data analysis utilizes the Independent Sample t-test. The study results indicate that the Project-Based Learning (PjBL) model significantly affects students' creative thinking skills. The experimental class using PjBL significantly outperformed the control group ($p = 0.001$). It can be concluded that PjBL improves students' creative thinking in IPAS learning.

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1. INTRODUCTION

Education plays a crucial role in addressing the challenges of the 21st century. Education is closely linked to the progression of time, as the logarithmic progression of education aligns with advancements in science and technology. The quality of education is closely tied to the quality of students, as the focus of learning is on the students themselves. Students are expected to acquire as much knowledge and understanding as possible through learning [1].

One of the subjects taught in school is IPAS, which stands for Natural and Social Sciences (IPAS). Natural Sciences (IPA) is a subject explored in school, with the concept of studying all objects found in nature, including humans, plants, animals, and objects (biotic and abiotic). According to Surahman [2], the purpose of studying Natural Sciences

is to instill a positive attitude toward science, technology, and society and to cultivate problem-solving skills in life, thereby educating students to think critically and objectively. The knowledge taught in Science at the elementary school level is directly related to the concrete world of humans, so learning it is more effective when focused on concrete aspects of human life—this is the purpose of studying Science, according to Surahman. Based on Piaget's learning theory, elementary school students are children aged 7–11 in the concrete operational stage. The concepts that form the basis of their thinking are concrete and tangible. This means that children will easily grasp lessons if they are shown real objects and things around them, such as examples, illustrations, or real objects and objects in the student's environment. This makes learning faster and more effective [3]. The science subject provides opportunities for students to gain a more comprehensive understanding of the natural world, enhance their ability to ask questions, find solutions to problems, and improve their thinking skills.

The National Education Association has outlined the skills needed in the 21st century as the 4Cs, which include the ability to think creatively and innovatively, communicate, think critically, and collaborate. 21st-century skills must be taught at all levels of education, especially in elementary schools (SD/MI), as students are experiencing rapid changes. Elementary school students are automatically becoming part of the 21st-century society. Therefore, 21st-century skills are taught at all elementary school levels (SD/MI) following the development and needs of the students.

Thinking skills can be defined as cognitive processes broken down into concrete steps that are then used as guidelines for thinking. One example of thinking skills is inferring, which is the ability to connect various clues and facts or information with existing knowledge to make a formulated prediction of the outcome [4]. In addition to critical thinking, one must possess creative thinking skills, as creative thinking is critical.

Creative thinking is a thought process that generates a wide range of ideas and approaches. When solving a problem, creative thinking will generate many practical ideas for finding a solution. As stated by Fajarwati, creative thinking skills enable students to meet their personal needs, as well as the needs of society and their race [5].

Thinking creatively means coming up with something novel (innovative). The thinking process underlying innovative products is the same as that of everyday activities (ordinary thinking) [6]. The ability to think creatively can be determined by one's skill in analyzing data and providing varied responses to problem-solving. High creativity indicates that a person is capable of thinking creatively. Complex thinking branches into cognitive and non-cognitive thinking. Creative thinking is one form of cognitive thinking [7].

Data from Nakano and Wechsler's research shows the necessity of artistic instruction, from primary to university, to motivate pupils to honestly want to acquire knowledge, explore new topics, and surpass what is taught in class. This shift toward education entails reconsidering instructional methods and challenging traditional teaching methods to inspire students and aspiring professionals to cultivate their inventive and creative abilities [8].

One important factor that can influence student creativity is learning motivation. Whether from intrinsic curiosity within the student or external sources, students are more curious to learn about something. If student learning motivation is increased, it will influence the improvement of their creative thinking abilities, and conversely, if their motivation is low, their creative thinking abilities will be lacking. Many factors influence this relationship, including school facilities and students' physiological and psychological factors [9].

Other factors that can influence children's creative thinking skills include emotional state. The National Scientific Council on the Developing Child, Center on the Developing Child at Harvard University, states that emotions are critical to overall brain architecture development and have significant consequences throughout life. This statement is supported by numerous research findings, including a study by Mastria Serena et al. [10], which suggests that emotional states can influence the evaluation of alternative creative ideas generated through divergent thinking [6].

Torrance formulated criteria for assessing creative thinking, including (1) Fluency, the ability to generate ideas quickly; (2) Flexibility, the ability to consider various approaches to a problem; (3) Originality, the tendency to produce ideas that are different from those of others in general; (4) Elaboration, the skill of thinking through the details of an idea and implementing it [11].

One learning model that can be used to develop students' creative thinking skills is the Project-Based Learning (PjBL) model. The Project-Based Learning (PjBL) model is an innovative learning model that emphasizes the concepts and principles of a particular discipline, engages pupils in meaningful assignments and problem-solving, provides pupils with the opportunity to work independently, construct and discover their knowledge, and produce valuable and realistic student-created products.

Project-based learning (PjBL) is a technique that brings innovation to learning. The role of the teacher in this model is as a guide, providing facilities for students to ask questions about theory and motivating them to learn actively. According to Yahya Muhammad Mukhlis, this learning model allows educators to control the learning process fully. The learning system incorporates project work into the process [12].

Learning through projects is a constructive learning framework that possesses the potential to strengthen advanced cognitive skills. Students design projects, work on complex tasks and evaluate their performance and progress. Projects are planned based on problems, questions, or needs identified by students [13]. Project-based learning is a learning model that applies a scientific approach by focusing on the basic concepts and principles of a subject, enabling students to investigate, solve, and address problems, problem-solving, and other meaningful tasks centered on the students and producing tangible products [14].

Project-based learning has several characteristics, namely: learners make decisions about a framework; learners are presented with problems or challenges; learners design processes to determine solutions to the problems or challenges presented; learners collaboratively take responsibility for accessing and managing information to solve problems; the evaluation process is carried out continuously; students regularly reflect on

the activities they have carried out, the final product of the activity is evaluated qualitatively, and the learning situation is highly tolerant of errors and changes [14]. The principles of the Project-Based Learning model are the principle of centrality, the principle of focusing on issues or topics, the principle of constructive investigation or design, the principle of autonomy, and the principle of realism [15].

Project-based learning involves six stages: identifying problems, designing projects, scheduling project implementation, monitoring project progress, testing project results, and evaluating learning experiences [11].

The disadvantages of the PjBL model include the need for significant time to resolve issues and generate a product. The PjBL learning model is unsuitable for students who easily give up, lack the necessary knowledge and skills, and struggle to collaborate with their peers [16]. Implementing the project-based learning model has several advantages, including enhancing students' motivation to learn, enabling students to solve problems quickly, fostering good communication with others, and helping students manage their time effectively [17].

There are currently few studies in the context of IPAS education, despite the Project-Based Learning (PjBL) model's theoretical ability to foster creative thinking. Examining how the PjBL model affects students' capacity for creative thought across various interdisciplinary subject areas is essential, especially at the primary and lower secondary education levels. In addition to providing evidence of how such teaching strategies can assist the development of 21st-century capabilities, this study aims to examine how Project-Based Learning affects students' creative thinking abilities in an IPAS learning environment.

2. METHOD

The research approach used in this research is quantitative. The quantitative approach is research that uses scientific rules, namely concrete/empirical, objective, measurable, rational, and systematic [18]. Data obtained from this research is data related to research variables. The type of research used in this research is a quasi-experiment. Quasi experiment is actual research if used in educational research. Quasi-experiments have class control but cannot function fully to control variables, such as external variables that influence the implementation of experiments.

2.1. Research Design

The type of research used in this study is quasi-experimental. The research approach used in this study is a quantitative approach with a pretest-posttest control group design. The research population comprises 44 students in grades IV B and IV C at SDN Gunung Gede Kota Bogor. The sample used is the entire grades IV B and IV C at SDN Gunung Gede Kota Bogor, totaling 44 students, with 22 students in grade IV B forming the experimental class and 22 students in grade IV C forming the control class, using a saturated sampling technique.

The research instruments consisted of validated tests, reliability tests, observations, and documentation. Validity testing measures how well an instrument performs its

intended functions. It is considered legitimate if the instrument can measure what you wish to measure. The Product Moment Correlation formula is then used to gauge the instrument's validity. On the other hand, reliability describes how well a measuring device captures what it is supposed to capture. Alpha Cronbach's formula was used to determine the test instruments' reliability in this investigation. Information about pupils' capacity for original thought was acquired through tests, while the implementation of learning using the Project-Based Learning (PjBL) and Problem-Based Learning (PBL) models was observed. Data on pupils' original thought capacity were examined using parametric statistical methods. The Independent sample t-test analysis began with tests for homogeneity and normalcy as requirements for parametric statistical testing. Data analysis was assisted by SPSS 25 for Windows.

2.2. Research Participants

Ethical issues are prioritized during the study process as part of the research design. All participants, pupils, and their parents or guardians gave informed consent before data was collected. Participants were given comprehensive explanations of the study's goals, methods, possible advantages, and dangers, and they were reassured that they could leave at any moment without incurring any fees. Additionally, the administration of the school formally grants authorization to undertake research. This ethically grounded study aims to add to the increasing body of knowledge on the contribution of novel pedagogical approaches, like PjBL, to developing creative thinking abilities critical for interdisciplinary learning in IPAS education.

3. RESULTS AND DISCUSSION

The study results indicate that implementing the Project-Based Learning (PjBL) model improves science education students' creative thinking skills. The subsequent is a breakdown of the information about pupils' creative thinking skills.

3.1. Results

3.1.1 Data Creative Thinking Ability IPAS Students in the Experimental Class

The students in the experimental class are those in class IV B, with 22 students. The comparison of pretest and posttest scores for the experimental class is presented as a graph.

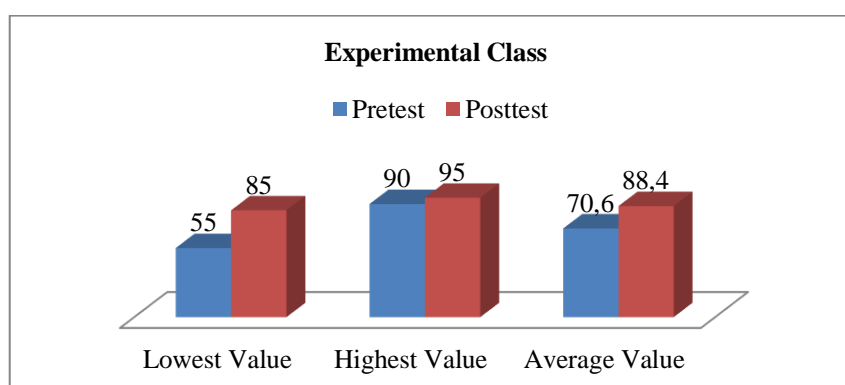


Figure 1. Comparison of Pretest and Posttest Scores in the Experimental Class

The Figure 1 shows that the lowest score, highest score, and average score of the experimental class increased from the pretest to the posttest. This is evidenced by the lowest score increasing from 55 to 85, the highest score rising from 90 to 95, and the average score increasing from 70.6 to 88.4.

3.1.2 Data on Creative Thinking Ability of IPAS Students in the Control Class

The students who became the control class were 22 students from class IV C. The comparison of the pretest and posttest scores of the control class is presented in the following graph.

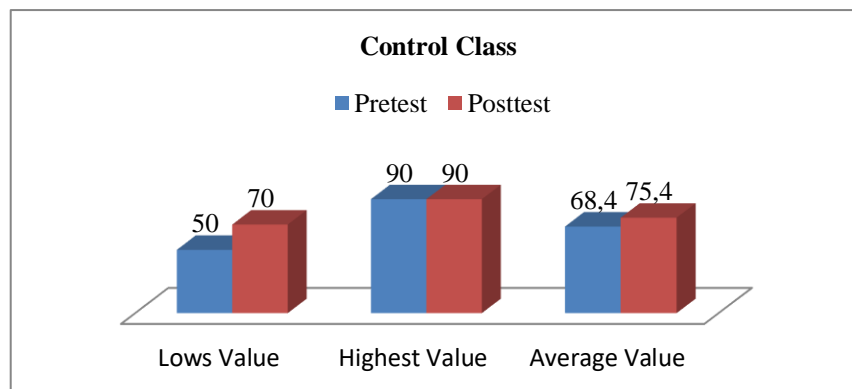


Figure 2. Comparison of Pretest and post-test scores in the Control Class

The Figure 2 shows that the lowest and average scores increased from the pretest to the posttest, while the highest score remained the same from the pretest to the posttest. This is evidenced by the lowest score rising from 50 to 70 and the average score increasing from 68.4 to 75.4, while the highest score of 90 remained the same.

3.1.3 Comparison of the Capacity for Creative Thought Data between Students in the Control and Experimental Classes

Table 1. Comparison Table of Pretest and Posttest Results in the Experimental Class and Control Class

Results of Creative Thinking Skills in IPAS Subjects	Experimental Class		Control Class	
	<i>Pretest</i>	<i>Posttest</i>	<i>Pretest</i>	<i>Posttest</i>
Average Value	70,6	88,4	68,4	75,4
Average Difference	17,8		7	

It is evident from the data that the average difference in posttest scores between the experimental class's pupils who used the Project-Based Education (PjBL) model and students in the class under control who used the PBL model is $17.8 > 7$. This means that the learning outcomes of students in the experimental class who used the Project Based Learning (PjBL) model were much higher than those of students in the control class who used the PBL model.

3.2. Discussions

Statistical prerequisite tests were conducted before hypothesis testing, namely normality and homogeneity tests on students' creative thinking abilities. The normality test results using the Kolmogorov-Smirnov test indicate that the data on pupils' capacity for original thought in both the control and experimental groups are normally distributed, with $P > 0.05$. The results of the homogeneity test using the Levene test indicate that all data on pupils' capacity for original thought in both the control and experimental groups have a P value > 0.05 , meaning that the data have homogeneous variance.

The hypothesis testing of students' creative thinking abilities was conducted using an independent sample t-test because it met the prerequisite tests, namely normally distributed data and uniform variance. The hypothesis's findings testing utilizing a t-test for independent samples showed a result of $0.001 < 0.05$, which means that the Project-Based Learning (PjBL) model effectively improves students' creative thinking in IPAS learning.

These results show a difference in the student's capacity for original thought in both the experimental and control groups. This aligns with the hypothesis test results on the posttest results of students' thinking abilities, which indicate a significant difference in students' creative thinking abilities in the experimental and control classes. The research findings of Kadek Arlian Dita Permana et al. [1] show a positive influence of the Project-Based Learning (PjBL) model on the creative thinking abilities of fifth-grade elementary school students. The differences observed during the learning process, particularly in Class IV A as the experimental class using the Project-Based Learning (PjBL) model, which is a model that uses problems as the initial step in learning and creates projects as the final step, aims to foster creative thinking. During the learning process, students were more actively engaged in projects. Using the Project-Based Learning (PjBL) model makes students more active and beneficial in enhancing their creative thinking abilities.

Creative thinking is a process that generates creativity. The better someone is at creative thinking, the greater their creativity. In other words, that person has high creativity. Involving students in designing their experimental procedures encourages their scientific creativity. Project-based learning requires students to conduct experiments to solve problems and complete assigned projects. Students' creative thinking is crucial in project creation [19].

Other pertinent research in this study demonstrates that the PjBL model has great potential to enhance elementary school students' creative thinking abilities. This gives teachers a foundation to incorporate the model into their lessons by encouraging students to cultivate their creative thinking abilities through real-world projects. Students are more motivated and involved in learning while using the PjBL paradigm. The completed projects allow students to work more actively, research topics, and engage in peer discussion [20], [21], [22], [23].

These results are consistent with prior research that found PjBL greatly enhanced students' creative learning competencies [24], [25]. The project-based learning approach successfully and efficiently accomplished the learning process. To improve their capacity for creative thought, students become more inventive in producing novel goods in comic media. The project-based learning paradigm has improved students' creativity, critical

thinking, and problem-solving skills. Students are now able to create comics to develop their creativity further.

This study shows that the value or results of students' capacity for original thought correspond to the teacher's teaching model. If the learning model applied by the teacher is appropriate, then the students' learning outcomes can reach the average. The next important thing is that teachers must understand that each student's cognitive abilities differ. Therefore, teachers must carefully evaluate their students' abilities to help students with difficulty achieving learning targets and determine the appropriate learning model for all students.

4. CONCLUSION

From the study results, it can be concluded that “there is an effect of implementing the Project Based Learning (PjBL) model to increase students' creative thinking in IPAS learning.” Thus, it is stated by sig. (2 tailed) from the post-test results of $0.001 < 0.05$, H_a is accepted. The results indicate a significant difference between the learning outcomes of students in the experimental class who learned using the Project-Based Learning (PjBL) model and those in the control class who used the PBL model. Therefore, it can be concluded that implementing the Project-Based Learning (PjBL) model impacts enhancing students' creative thinking in IPAS learning, thereby providing higher development.

The study's conclusions offer insightful information for educators, curriculum designers, and legislators looking to enhance students' capacity for creative thought, especially within the IPAS framework. Higher-order thinking skills can be developed by including project-based learning in the IPAS curriculum, as demonstrated by the sound effects of PjBL on creative thinking. To create IPAS learning activities that demand students to research, investigate, and offer original solutions, teachers should be encouraged and educated to do so. This study demonstrates that by giving learning greater purpose, PjBL fosters creativity and raises student engagement.

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