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Effectiveness Of Pjbl-Based Steam Learning Model On Students' Creativity Mis Al Islam Bengkulu

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ABSTRACT

This study aims to determine the effectiveness of the STEAM (Science, Technology, Engineering, Art, and Mathematics) learning model based on Project-Based Learning (PjBL) on the creativity of fifth-grade students at MIS Al Islam Bengkulu. The study was motivated by the students' low level of creativity during the learning process, characterized by a lack of confidence in expressing ideas, low participation, and limited opportunities for creative expression. A quantitative approach was employed using a quasi-experimental method with a Nonequivalent Control Group Design. The sample consisted of two classes totaling 50 students: Class V-A served as the experimental group receiving STEAM-PjBL instruction, while Class V-B served as the control group receiving conventional instruction. Data collection techniques included tests (pre-test and post-test), observation, and documentation. Data analysis involved normality tests, homogeneity tests, independent t-tests, and N-Gain calculations. The results showed that the experimental group achieved an average post-test creativity score of 83.4, compared to 70.6 for the control group; the significance value of p = 0.001 (<0.05) indicated a significant difference. N-Gain analysis revealed a creativity improvement of 0.60 in the experimental group (moderate-to-high category), whereas the control group showed an improvement of 0.23 (low-to-moderate category). Observations also indicated high levels of student engagement in discussions, project design, and the presentation of results. Thus, it can be concluded that the STEAM learning model based on Project-Based Learning (PjBL) is effective in enhancing student creativity at MIS Al Islam Bengkulu.

Introduction

Education serves as the primary foundation for developing high-quality human resources capable of navigating the evolving times and global challenges. At the primary school level, the educational process focuses not only on mastering subject matter but also on fostering thinking skills, social skills, and creativity, as well as shaping character. Primary school represents a

crucial initial stage in unlocking student potential, as this is the phase where students begin to develop their cognitive, affective, and psychomotor abilities in an integrated manner. Consequently, the learning process in primary schools must be designed innovatively to create meaningful learning experiences and encourage active student engagement.

As we enter the 21st century, education is undergoing a shift that emphasizes the importance of mastering "21st-century skills" to equip learners for advancements in science and technology. These skills including critical thinking, creativity, communication, and collaboration are essential for supporting both the learning process and future life. In the context of primary education, creativity stands out as a vital competency to be cultivated from an early age, as it enables students to articulate thoughts, generate new ideas, and devise solutions to the various problems encountered in daily life. Therefore, instruction should be designed to provide students with opportunities to participate actively, explore ideas, and develop their potential to the fullest (Astuti, 2025).

Creativity is a higher-order thinking skill that is crucial to cultivate within the educational process. It is demonstrated by a learner's ability to generate novel ideas, identify various problem-solving alternatives, and develop concepts in a flexible and original manner. Creativity is not solely focused on producing something new; it also entails the ability to process existing knowledge and apply it in diverse contexts. In an educational setting, creativity serves as a key indicator, reflecting a student's capacity to construct understanding independently and apply knowledge to solve real-life problems (Nadhiroh, 2022).

Fostering student creativity depends on the teacher's role in designing a learning process that encourages active student engagement. Teachers act not merely as conveyors of information but as facilitators who provide opportunities for students to explore ideas, express opinions, and discover solutions to the challenges they encounter. A learning environment that allows for freedom of thought and active participation supports the development of students' creative abilities. Conversely, teacher-centered instruction dominated by one-way information delivery tends to limit opportunities for students to develop their creativity and inherent potential (Rohimah & Sari, 2023).

However, learning conditions in elementary schools still present various obstacles to the development of student creativity. Learning processes dominated by conventional methods often position students merely as recipients of information, rather than active participants in the discovery and development of knowledge. Consequently, students become unaccustomed to expressing their opinions, lack confidence in sharing ideas, and struggle to develop solutions to the problems they encounter.

Preliminary observations at MIS Al Islam Bengkulu revealed that student creativity within the learning process has not yet developed optimally. This situation is evidenced by low student participation during lessons, a lack of confidence in voicing opinions, a scarcity of discussion activities, and limited opportunities to explore and develop ideas through contextual learning experiences. Furthermore, most learning activities remain focused on content delivery and practice exercises, failing to provide sufficient scope for students to cultivate creative thinking and problem-solving skills.

These issues highlight the need for a learning model capable of actively engaging students in the learning process, providing authentic learning experiences, and integrating multiple disciplines into a single learning activity. One approach considered relevant to addressing these needs is the STEAM (Science, Technology, Engineering, Art, and Mathematics) approach combined with Project-Based Learning (PjBL).

STEAM is a learning approach that integrates science, technology, engineering, art, and mathematics into an interconnected learning process oriented toward contextual problem-solving. This approach places students at the center of learning through various exploratory activities that foster creative, collaborative, and innovative thinking skills. Integrating the

element of art into STEAM provides students with opportunities to express ideas, develop their imaginations, and generate more diverse and meaningful solutions during the learning process (Ferianto et al., 2024).

Project-Based Learning (PjBL) is a learner-centered model that utilizes project-based activities to create products or solve real-world problems. This model offers students the chance to gain hands-on learning experiences through exploration, group collaboration, information gathering, and the presentation of learning outcomes. PjBL is implemented through several stages: defining a fundamental question, planning the project, scheduling activities, executing and monitoring the project, assessing results, and evaluating the learning experience gained throughout the process (Sari et al., 2023).

Combining the STEAM approach with the Project-Based Learning model is believed to create a more active and meaningful learning environment. Through PjBL-based STEAM learning, students not only gain a theoretical understanding of concepts but also develop creativity by designing, creating, testing, and refining products based on their explorations. This type of learning enables students to experience a more authentic learning process, thereby allowing their creative thinking skills to develop optimally.

Several studies indicate that the implementation of STEAM learning based on Project-Based Learning (PjBL) contributes positively to students' learning processes and outcomes. Integrating the STEAM approach into project-based activities enhances student engagement, strengthens conceptual understanding, and fosters the development of critical thinking and problem-solving skills. Furthermore, project activities that require students to design, explore, and create products provide greater scope for the development of creativity. Through group work and the presentation of project results, students also develop communication and collaboration skills—key components of 21st-century competencies (Rahman et al., 2025).

However, research specifically examining the effectiveness of the STEAM-PjBL learning model on the creativity of elementary school students remains relatively limited, particularly within the context of elementary schools in Seluma Regency. Most prior studies have focused primarily on improving learning outcomes or critical thinking skills, while in-depth analysis of creativity as a primary variable remains scarce. Therefore, there is a need for research that provides empirical evidence regarding the impact of the STEAM-PjBL learning model on student creativity.

Based on this background, this study aims to analyze the effectiveness of the STEAM-PjBL learning model on the creativity of fifth-grade students at MIS Al Islam Bengkulu. This research is expected to contribute theoretically to the development of studies on innovative learning and offer practical benefits for teachers in designing instruction that is creative, collaborative, and aligned with the demands of 21st-century education.

Method

This study employs a quantitative approach using a quasi-experimental method with a Nonequivalent Control Group Design. This design was selected because, while the researcher did not fully randomize the subjects, the study still involved both experimental and control groups to compare the effects of the administered treatment. Both groups underwent a pre-test prior to the treatment and a post-test afterward to assess changes in students' creativity levels resulting from the implementation of the learning model (Sugiyono, 2020). The research was conducted at SDN 45 Seluma during the even semester of the 2025/2026 academic year. The study population comprised all students at SDN 45 Seluma, while the sample was selected using purposive sampling a technique involving sample selection based on specific criteria aligned with the research objectives (Creswell & Creswell, 2018).

The sample consisted of 50 students: Class V A served as the experimental group, and Class VB served as the control group. Data collection involved testing, observation, and documentation. Test instruments (pre-test and post-test) were used to measure student creativity based on indicators of creative thinking: fluency, flexibility, originality, and elaboration (Munandar, 2014). Observation was used to gather information on student

engagement during the learning process, while documentation served as supporting data, including project results and records of learning activities. Data analysis included the Shapiro–Wilk normality test, Levene's homogeneity test, an independent sample t-test to determine differences in outcomes between the experimental and control groups, and N-Gain analysis to measure the extent of improvement in student creativity. Decision-making was based on a significance level of 0.05; a Sig. value of < 0.05 indicates a significant difference between the groups.

Results and Discussion

1. Pre-test and Post-test Results of Student Creativity

This study was conducted to determine the effectiveness of implementing a STEAM (Science, Technology, Engineering, Art, and Mathematics) learning model based on Project-Based Learning (PjBL) on the creativity of fifth-grade students at MIS Al Islam Bengkulu. Creativity was measured in two stages: a pre-test administered before the intervention and a post-test administered after the learning process concluded. Both tests aimed to observe changes in students' creative abilities following a distinct learning experience.

Data analysis revealed that, prior to the intervention, the creative abilities of students in both the experimental and control groups were relatively similar. The experimental group achieved an average pre-test score of 62.1, while the control group averaged 61.7. This slight difference indicates that both groups possessed comparable baseline abilities, making them suitable for comparing the effectiveness of the implemented learning model.

A post-test was administered after several learning sessions. The results showed a significant improvement in the experimental group; their average post-test score rose to 83.4, whereas the control group reached only 70.6. This disparity indicates that students taught using the PjBL-based STEAM model experienced a greater increase in creativity compared to those taught using conventional methods. In the experimental group, students appeared more active in developing ideas, formulating project concepts, connecting various pieces of information, and generating diverse solutions to the problems presented.

To determine whether this difference was statistically significant, an independent t-test was conducted. The analysis yielded a significance value of 0.001 ($p < 0.05$), indicating a significant difference between the experimental and control groups following the intervention. These findings demonstrate that PjBL-based STEAM learning positively influences the enhancement of student creativity. This is attributed to the model providing students with opportunities to learn through hands-on experience, explore various possibilities, and develop ideas into tangible, functional products.

2. Results of N-Gain Analysis on Student Creativity Improvement

In addition to comparing pre-test and post-test results, this study employed N-Gain analysis to determine the extent of the increase in student creativity following the intervention. The analysis revealed that the experimental group achieved an N-Gain score of 0.60 falling within the medium-to-high category whereas the control group scored 0.23, placing them in the low category. These figures indicate that STEAM-based Project-Based Learning (PjBL) fosters more effective improvement than conventional instruction. The medium-to-high category suggests that the majority of students experienced significant development throughout the learning process.

The boost in creativity within the experimental group was evident in the changing ways students approached assigned tasks and projects. Initially, most students tended to provide simple answers and follow the teacher's examples. However, following the implementation of STEAM-PjBL, students began demonstrating the ability to generate alternative ideas, modify project designs, and create a wider variety of products.

Based on the creativity indicators used in the study, the improvement in student creativity

was observed across four key aspects: fluency, flexibility, originality, and elaboration. These four aspects are widely used indicators for measuring creative thinking skills, particularly within the framework of the Torrance Tests of Creative Thinking (TTCT) (Alabbasi et al., 2022). The study results indicate that the implementation of STEAM-based Project-Based Learning (PjBL) contributed to the development of all these aspects of creativity.

Regarding fluency, students demonstrated an improved ability to generate a greater number of ideas when presented with a problem or project task. After participating in STEAM-PjBL, students were no longer fixated on a single answer; instead, they began exploring various potential solutions and generating a more diverse range of alternative ideas. This shift reflects the development of divergent thinking skills, characterized by the ability to produce multiple ideas relevant to a specific problem. According to Alabbasi et al. (2022), fluency is an individual's capacity to generate numerous meaningful and appropriate responses or ideas in reaction to a given stimulus.

Improvements were also observed in the aspect of flexibility. Students began to view problems from different perspectives and employ various strategies to complete their assigned projects. Throughout the learning process, students did not rely on a single problem-solving method; instead, they began connecting diverse concepts and adapting their approaches to meet project requirements. This ability demonstrates a development in cognitive flexibility—a key characteristic of creativity. According to Alabbasi et al. (2022), flexibility refers to the capacity to generate a variety of idea categories and to shift between different modes of thinking to achieve more effective solutions.

Regarding originality, students' project outcomes revealed the emergence of unique ideas that went beyond merely imitating examples provided by the teacher. The resulting products began to exhibit distinctive characteristics in terms of design, function, and execution. This indicates that students were becoming capable of generating ideas that possessed an element of novelty and differed from typical responses. As defined by Torrance (and reiterated by Alabbasi et al., 2022), originality is the ability to produce ideas that are rare or possess a higher degree of novelty compared to conventional responses.

Furthermore, improvements were evident in the aspect of elaboration. Students demonstrated the ability to expand their ideas into more detailed, systematic, and structured forms, resulting in superior products. During the project work, students paid attention to design details and product functionality, while also making improvements and refining the final outcome through iterative evaluation. This capacity for elaboration shows that students were not merely generating ideas but were also able to develop them into more mature and practical creations. According to Alabbasi et al. (2022), elaboration is the ability to add details, enrich concepts, and transform simple responses into more complex products.

Overall, the improvements across these four indicators demonstrate that implementing STEAM learning through Project-Based Learning (PjBL) provides students with greater scope for creative thinking, the development of diverse problem-solving alternatives, and the creation of products that are more innovative and meaningful than those resulting from conventional instruction. These changes demonstrate that project-based learning provides students with greater scope for creative thinking compared to conventional learning

3. Observations of Student Activities and Documentation of Project Products During Instruction

Using test instruments to measure improvements in student creativity, this study conducted direct observations during the learning process and documented the project outcomes produced by students. These served as supporting data to provide a more comprehensive picture of changes in learning behavior and the tangible forms of creativity that emerged during the implementation of the STEAM (Science, Technology, Engineering, Art, and Mathematics) model based on Project-Based Learning (PjBL). Observations made during the learning process revealed that the STEAM-PjBL model fostered a learning environment that was more active, collaborative, and focused on direct student engagement compared to conventional instruction. Students in the experimental group demonstrated high levels of

participation: approximately 90% were actively involved in group discussions, 85% participated in project planning and execution, and 80% displayed confidence when presenting their work to the class. This high level of participation indicates that students were no longer passive recipients of information but had begun to act as key participants in constructing knowledge through authentic learning experiences.

Throughout the learning process, students frequently interacted with group members to discuss ideas, determine project designs, assign responsibilities, outline work steps, and resolve various issues that arose during the project's execution. During the planning stage, students learned to set project goals, create initial drafts, consider potential obstacles, and estimate the tools and materials needed to produce a final product aligned with their planned concepts. Subsequently, during the project implementation and development stages, students demonstrated the ability to collaborate, communicate, make decisions, and solve problems with greater independence. These conditions indicate that learning activities focused not only on achieving final outcomes but also on providing experiences that cultivated students' higher-order thinking skills and social capabilities. These findings align with research conducted by Han et al. (2023), which explains that project-based STEAM learning can enhance student engagement by providing opportunities for students to actively participate in processes of exploration, investigation, and the creation of products relevant to real-life contexts. Project-centered learning is also considered capable of boosting learning motivation, as students gain hands-on experience in applying learned concepts to authentic situations.

In addition to increased student engagement during the learning process, documentation of the project products collected during the study also provides concrete evidence of the development of student creativity. Based on this documentation, students in the experimental group successfully produced various items demonstrating an integrated application of STEAM principles—such as an automated height-measuring device, an ecosystem model equipped with a temperature sensor, and a bridge prototype constructed from popsicle sticks. These products not only reflect the students' grasp of the subject matter but also demonstrate their ability to integrate science, technology, engineering, arts, and mathematics into creations that possess both functionality and practical value. Each project was evaluated based on several indicators, including the originality of the idea, product functionality and utility, design creativity, accuracy in applying concepts, the neatness of the final result, and the students' ability to present their work. The assessment results indicate that the majority of projects fell into the "good" to "very good" categories, suggesting that students not only understood the concepts theoretically but were also capable of applying them to create tangible solutions through creative and systematic thinking processes.

These achievements demonstrate that STEAM-based Project-Based Learning does more than just improve academic grades; it also fosters the development of students' creative thinking, practical skills, communication abilities, and collaborative capabilities. Through project activities, students have the opportunity to experience the entire learning cycle—from identifying a problem, designing a solution, and conducting experiments to evaluating outcomes and producing a final product for presentation. Such learning experiences provide students with greater scope to construct their own understanding and more effectively develop 21st-century skills. These findings are supported by research conducted by Perignat and Katz-Buonincontro (2019), which states that integrating STEAM into project-based learning enhances creativity, problem-solving skills, collaboration, and the quality of learning outcomes by encouraging students to connect various disciplines within a single, meaningful learning experience. Furthermore, research by Herro and Quigley (2017) indicates that STEAM learning, which places students at the center of the learning process, positively impacts the enhancement of creativity and learning engagement, as students gain greater opportunities to explore, experiment, and produce work independently.

Overall, observations of student activities and documentation of project products indicate that the implementation of a STEAM-based Project-Based Learning (PjBL) model is effective in enhancing the creativity of fifth-grade students at SDN 45 Seluma. This effectiveness is evidenced by increased student engagement during the learning process, the development of teamwork and problem-solving skills, and the improved quality of the resulting products. Student-centered learning through project activities creates a learning experience that is contextual, meaningful, and relevant to 21st-century educational needs, thereby serving as an effective and innovative alternative to foster students' critical thinking, communication, collaboration, and creativity skills.

Conclusion

Based on the research findings, it can be concluded that the implementation of the STEAM (Science, Technology, Engineering, Art, and Mathematics) learning model based on Project-Based Learning (PjBL) has proven effective in enhancing the creativity of fifth-grade students at SDN 45 Seluma. This is demonstrated by the improvement in creativity learning outcomes in the experimental group compared to the control group after receiving the learning treatment. The analysis showed that the average post-test score for the experimental group reached 83.4, higher than the score for the control group at 70.6, with a significance value of p = 0.001 (<0.05), indicating a significant difference. Furthermore, the N-Gain analysis of 0.60 in the experimental group indicates an increase in creativity in the medium-high category, while the control group only achieved 0.23, in the low category. The research findings also indicate that the implementation of STEAM based on PjBL can increase student engagement during the learning process. Students become more active in discussions, confidently express ideas, are able to work collaboratively in groups, and demonstrate improved skills in developing and presenting project results. The products produced by students demonstrate the integration of cross-disciplinary knowledge while demonstrating more developed creative thinking skills. Thus, the Project-Based Learning (PBL)-based STEAM learning model can be used as an alternative innovative learning model in elementary schools because it not only enhances student creativity but also supports the development of 21st-century skills such as critical thinking, communication, collaboration, and problem-solving. Future research is recommended to expand the scope of the study with a larger sample size, longer learning duration, and the addition of other variables such as critical thinking skills, learning motivation, and student learning outcomes to obtain a more comprehensive picture of the effectiveness of the PjBL-based STEAM learning model.

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