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Implementation of the Steam-Integrated Project-Based Learning Model to Improve IPAS Learning Activities and Outcomes

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Abstract

This study was motivated by the fact that many students remain passive in the learning process and struggle to understand the topic "Daerahku Kebanggaanku," resulting in suboptimal learning outcomes. The purpose of this research was to determine the effect of implementing a STEAM-integrated Project Based Learning (PjBL) model on improving students' learning activities and outcomes in IPAS. The STEAM-integrated Project Based Learning model is a project-based instructional approach that can develop essential 21st-century skills, such as communication, teamwork, analytical thinking, and creativity. During the project process, students learn to collaborate, express ideas, and solve problems collectively. This approach not only prepares students for academic success but also equips them to become adaptive and innovative individuals in facing future challenges. This research employed a quantitative approach using a quasi-experimental design, with the research subjects being students of class VA at SDN Sukun 1 Malang City. The instruments used included learning outcome evaluation tests, learning activity questionnaires, and observation sheets. Data analysis was conducted using the paired-samples t-test in SPSS 26.00. The results of the study indicated a significant improvement in students' learning activities and outcomes after the implementation of the STEAM-integrated Project Based Learning model. These findings demonstrate that the STEAM-integrated Project Based Learning model is effective for use in IPAS learning to enhance students' learning activities and outcomes. The results of this study are expected to serve as a reference for teachers in implementing project-based learning models and to contribute to the development of contextual and engaging IPAS instruction.

Keywords Project Based Learning Model, STEAM, Learning Activities, Learning Outcomes

INTRODUCTION

Education is a crucial aspect in improving the quality of human resources and the standard of living of the Indonesian people, enabling them to compete in the global era. Education plays a crucial role in preparing individuals with the knowledge, skills, and attitudes necessary for development. Therefore, education quality is continuously improved through various efforts, such as enhancing teacher competency, improving the curriculum, and providing adequate learning facilities and infrastructure (Muzaini dkk., 2024a). With the changing times, learning in the 21st century requires students not only to master material but also to develop critical, creative, collaborative, and communicative thinking skills. This requires teachers to be able to deliver innovative and meaningful learning, especially at the elementary school level, which is the initial foundation for developing students' thinking skills (Zayyinah dkk., 2022a).

The implementation of the Independent Curriculum in elementary schools integrates science and social studies into Natural and Social Sciences (IPAS). This integration aims to enable students to understand the environment more holistically, from both natural and social perspectives. Through IPAS learning, students are expected to understand the interrelationships between humans, the environment, and social phenomena, as well as develop social skills through collaborative activities (Wahyudi dkk., 2024). However, in practice, science learning still tends to be theoretical and less contextual, so students are less actively involved in learning. This impacts low student activity and learning outcomes. This problem was also found at SDN Sukun 1, especially in the material "My Region My Pride." Based on the results of observations and interviews, students had difficulty understanding the material, tended to be passive, and were less involved in the learning process. Student learning outcomes were also still low, with an average score of 69.23, where only 23% of students achieved mastery, while the other 76% did not meet the established criteria (Sucilestari dkk., 2025).

This situation indicates that the current learning process has not been able to optimize students' potential. Elementary school students are at a crucial developmental stage in fostering curiosity, creativity, and exploratory abilities. Therefore, a learning model is needed that actively engages students and provides meaningful learning experiences (Hayyun & Setiowati, 2023). One learning model that can be used is Project-Based Learning (PjBL), which emphasizes active student engagement through contextual project activities. Through this model, students are encouraged to think critically, collaborate, and communicate ideas effectively. However, to address the complexity

of science and science learning, PjBL needs to be integrated with the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach (Amin, 2021a).

However, previous studies have primarily focused on examining the effectiveness of Project-Based Learning (PjBL) and the STEAM approach in improving students' creativity and critical thinking skills. There is still a lack of studies that specifically investigate their impact on students' learning activities and learning outcomes in IPAS, particularly at the fifth-grade elementary school level. Therefore, this study seeks to fill this gap by analyzing how the integration of PjBL with the STEAM approach influences students' learning activities and learning outcomes in IPAS for grade V students (Simanjuntak dkk., 2025).

Sukun 1 Elementary School's vision is to create students who excel in faith, piety, science, and technology, character, and environmental awareness. However, the reality in the classroom shows that the learning process has not fully supported the achievement of this vision, particularly in fostering students' active participation and optimal learning outcomes. This condition is in line with findings from previous studies which indicate that conventional learning methods tend to limit students' engagement and mainly emphasize cognitive aspects such as creativity and critical thinking, without sufficiently addressing students' learning activities and overall learning outcomes. Therefore, it is necessary to implement an innovative learning model that not only enhances higher-order thinking skills but also improves students' learning activities and outcomes, so that the school's vision can be achieved more effectively. (Munfarida dkk., 2025).

Therefore, this study aims to analyze the implementation of the STEAM-integrated Project-Based Learning (PjBL) model in improving students' learning activities and learning outcomes in IPAS. Specifically, this research seeks to examine how the integration of STEAM within the PjBL model can enhance students' active participation during the learning process as well as improve their understanding and achievement in IPAS subjects at the elementary school level.

METHOD

This study employs a quantitative approach with a quasi-experimental method aimed at determining the effect of implementing the STEAM-integrated Project-Based Learning (PjBL) model on students' learning activities and learning outcomes in IPAS, particularly in the topic "My Region, My Pride." The quasi-experimental method was selected because the researcher could not randomly assign subjects to groups, thus utilizing existing classes as research groups (Abdussamad & Sik,

2021).

The research design used was the Nonequivalent Control Group Design, which involved two groups: an experimental group and a control group. Both groups were administered a pretest to measure students' initial abilities. The experimental group was then given treatment through the implementation of the STEAM-integrated PjBL model, while the control group received conventional learning. After the treatment, both groups were given a posttest to measure changes in students' learning activities and learning outcomes.

The independent variable in this study was the STEAM-integrated Project-Based Learning model, while the dependent variables were students' learning activities and learning outcomes in IPAS (Alaslan, 2023). The population of this study consisted of all students of SDN Sukun 1 Malang City. The sample was determined using a non-probability sampling technique, specifically purposive sampling. This technique was used because the selection of the sample was based on specific considerations, such as similarities in students' academic abilities, classroom conditions, and learning characteristics that support the implementation of the research treatment.

The sample included students from class VA and class VB in the 2025/2026 academic year, with a total of 55 students. Class VA was assigned as the experimental group, while class VB was assigned as the control group. The selection of these classes was based on the consideration that both classes have relatively similar characteristics in terms of students' abilities, learning activities, and curriculum implementation, making them suitable for comparison within a quasi-experimental design.

The data used in this study were primary data obtained directly from teachers and students. The data included students' learning activities and IPAS learning outcomes after the implementation of the learning model. Data collection techniques included tests, questionnaires, and observations. The test was used to measure students' learning outcomes through pretest and posttest in the form of multiple-choice questions. Questionnaires were used to assess students' learning activities, while observations were conducted to examine students' engagement during the learning process (Arikunto, 2019).

The research instruments consisted of a 20-item multiple-choice test, a learning activity questionnaire, and an observation sheet. The independent variable was implemented through the stages of the STEAM-integrated PjBL model. Meanwhile, the dependent variables included students' learning activities, which refer to students' physical, mental, and emotional involvement

in the learning process, and learning outcomes, which reflect the level of students' competency achievement after participating in the learning process (Roosinda et al., 2021).

The collected data were analyzed using statistical analysis techniques. Prior to hypothesis testing, prerequisite tests were conducted, including normality and homogeneity tests, to ensure that the data were normally distributed and had homogeneous variance.

Hypothesis testing was then conducted using two types of t-tests. The independent sample t-test was used to determine differences in students' learning activities and learning outcomes between the experimental and control groups based on posttest scores. In addition, the paired sample t-test was used to analyze differences within each group by comparing pretest and posttest results. The decision-making criteria were based on a significance value of less than 0.05, indicating that the implementation of the STEAM-integrated Project-Based Learning model has a significant effect on improving students' learning activities and learning outcomes in IPAS.

FINDINGS AND DISCUSSION

FINDINGS

This study was conducted at SDN Sukun 1 Malang City with the objective of determining the effect of the STEAM-integrated Project-Based Learning (PjBL) model on students' learning activities and learning outcomes in IPAS on the topic "My Region, My Pride." The subjects consisted of 55 students, including 27 students in the experimental class and 28 students in the control class.

The research instruments included tests, questionnaires, and observation sheets that had been tested for validity and reliability using SPSS 26.0. The validity test results showed that all items had an r-count value greater than the r-table value (0.381), indicating that all items were valid. The reliability test results showed that Cronbach's Alpha values were greater than 0.6, indicating that the instruments were reliable.

Table 1. Reliability Test Results

Variables	Cronbach's Alpha	Information
Learning Outcomes	0.815	Reliable
Learning Activities	0.852	Reliable

Descriptive analysis results showed an increase in learning activities and learning outcomes in the experimental class after the implementation of the STEAM-integrated PjBL model.

Table 2. Descriptive Statistics of Pretest and Posttest

Variables	Class	Pretest (Mean)	Posttest (Mean)
Learning Activities	Experiment	51.33	60.81
Learning Activities	Control	52.21	53.93
Learning Outcomes	Experiment	59.63	75.56
Learning Outcomes	Control	60.00	63.03

Based on Table 2, the increase in scores in the experimental class is higher than in the control class, both in learning activities and learning outcomes.

Furthermore, prerequisite tests were conducted. The results of the normality test using Kolmogorov-Smirnov showed that all data were normally distributed (Sig. > 0.05). The homogeneity test also indicated that the data had homogeneous variance (Sig. > 0.05).

Within-Group Analysis (Paired Sample t-test)

Table 3. Paired Sample t-test Results

Variables	Class	Sig. (p-value)	Information
Learning Activities	Experiment	0.000	Significant
Learning Activities	Control	0.162	Not Significant
Learning Outcomes	Experiment	0.000	Significant
Learning Outcomes	Control	0.118	Not Significant

The results indicate a significant difference between pretest and posttest scores in the experimental class ($p < 0.05$), while no significant difference was found in the control class ($p > 0.05$).

Between-Group Analysis (Independent Sample t-test)

Table 4. Independent Sample t-test Results (Posttest)

Variables	Sig. (2-tailed)	Information
Learning Activities	0.001	Significant
Learning Outcomes	0.000	Significant

The results of the independent sample t-test show significant differences between the experimental and control groups in posttest scores ($p < 0.05$).

Gain Score Analysis

Table 5. Gain Score Results

Variables	Class	Gain Score	Category
Learning Activities	Experiment	0.19	Medium
Learning Activities	Control	0.04	Low
Learning Outcomes	Experiment	0.39	Medium
Learning Outcomes	Control	0.07	Low

The gain score analysis shows that the improvement in the experimental class is higher than in the control class, particularly in learning outcomes.

Effect Size Analysis

Table 6. Effect Size (Cohen's d)

Variables	Effect Size (d)	Category
Learning Activities	0.80	Large
Learning Outcomes	1.10	Large

The effect size results indicate that the implementation of the STEAM-integrated PjBL model has a large effect on improving both learning activities and learning outcomes.

Mastery Learning

Table 7. Percentage of Learning Mastery

Class	Students Completed	Percentage
Experiment	23/27	85.19%
Control	15/28	53.57%

The percentage of mastery learning in the experimental class is higher than in the control class, indicating better learning achievement.

Based on the results of the paired sample t-test, independent sample t-test, gain score, effect size, and mastery learning analysis, it can be concluded that H0 is rejected and H1 is accepted. This means that the implementation of the STEAM-integrated Project-Based Learning (PjBL) model has a significant effect on improving students' learning activities and learning outcomes in IPAS on the topic "My Region, My Pride."

Discussion

The results of this study revealed a significant difference between learning using the STEAM-integrated Project-Based Learning (PjBL) model and conventional learning. This finding is supported by the results of the independent sample t-test, which showed a significance value of less than 0.05, indicating a significant difference between the experimental and control classes. In addition, the experimental class demonstrated higher gain scores, large effect sizes, and a higher percentage of learning mastery compared to the control class. This indicates that a learning model emphasizing active student involvement can effectively improve both learning activities and learning outcomes.

The Project-Based Learning model integrated with STEAM provides students with opportunities to engage in active and meaningful learning through hands-on experiences. Students are not only recipients of information but are also involved in the processes of exploring, designing, and solving real-world problems. This is in line with Santoso (2020), who states that learning models play a crucial role in creating a conducive learning environment that supports the development of critical and creative thinking skills.

In contrast, conventional learning, which tends to be teacher-centered, results in lower student engagement. This is evident from the control class data, which showed low gain scores and no significant improvement based on the paired sample t-test results ($p > 0.05$). As a result, students become more passive, which impacts both their learning activities and outcomes. Therefore, innovative learning approaches are needed to foster active student participation, one of which is the STEAM-integrated Project-Based Learning model.

The Influence of the STEAM-Integrated Project Based Learning Model on Learning Activities

The results of this study indicate that the implementation of the STEAM-integrated PjBL model significantly improves students' learning activities. This is supported by the paired sample t-test results in the experimental class, which showed a significance value of less than 0.05, indicating a significant increase between pretest and posttest scores. In addition, the gain score for learning activities in the experimental class was categorized as medium, while the control class was in the low category. The effect size also showed a large category, indicating that the model had a strong impact on students' learning activities. (Zayyinah dkk., 2022). This improvement occurs because the PjBL model places students at the center of the learning process (student-centered learning). Students are actively involved in observing, discussing, designing projects, and presenting their work. These activities simultaneously engage cognitive, affective, and psychomotor domains (Muzaini dkk., 2024).

These findings are consistent with previous studies, such as Yulita Ling Ling and Hendrikus Torimtubun, which found that integrating STEAM into Project-Based Learning can increase student engagement and interest in learning. Similarly, Suryaningsih stated that this model supports the development of 21st-century skills, including critical thinking, collaboration, communication, and creativity (Amin, 2021).

(Chung dkk., 2022) Furthermore, the increase in learning activities is also supported by the theory that learning activities involve interactions between students and their learning environment.

(Permana dkk., 2023) also stated that Project-Based Learning can increase student engagement because learning is centered on project activities. Students not only receive material but also become the main actors in the learning process. This increase in learning activity is also supported by (Atika dkk., 2023) theory, which states that effective learning must stimulate curiosity, encourage creativity, and actively engage students. (Anugrahsari & Syamsiah, 2025)also emphasized that student involvement in exploration, discussion, and reflection can significantly enhance learning activity. Thus, it can be concluded that the implementation of the Project Based Learning model integrated with STEAM is able to significantly increase student learning activities because it provides a meaningful, contextual, and collaborative learning experience.

The Influence of the STEAM-Integrated Project Based Learning Model on Learning Outcomes

In addition to improving learning activities, the STEAM-integrated PjBL model also significantly enhances students' learning outcomes. This is supported by the paired sample t-test results in the experimental class ($p < 0.05$) and the independent sample t-test results showing significant differences between the experimental and control classes. The gain score for learning outcomes in the experimental class was categorized as medium, while the control class remained in the low category. Moreover, the effect size was classified as large, indicating that the implementation of the model had a strong impact on improving students' learning outcomes. This is further supported by the percentage of learning mastery, where the experimental class achieved a higher completion rate compared to the control class. (Muzaini dkk., 2024).

This improvement in learning outcomes can be explained through cognitive theory, which states that learning will be more effective if students are directly involved in the learning process. In the Project Based Learning model, By integrating STEAM, students learn through real experiences, so that understanding of concepts becomes deeper and more meaningful. This aligns with the opinion of Kokotsaki, Menzies, & Wiggins (2020), who stated that Project-Based Learning provides students with the opportunity to understand material through direct experience. In the context of this study, students learned the material "My Region, My Pride" through a project related to their local environment (Rohman dkk., 2021).

Furthermore, STEAM integration also provides an interdisciplinary approach that enriches students' understanding. Yakman (2021) stated that the STEAM approach encourages students to think critically and creatively through the integration of science, technology, engineering, art, and mathematics. The results of this study also align with research by (Hidayati & Mustaghfiroh, 2024)

which showed that Project-Based Learning integrated with STEAM significantly improves student learning outcomes. This is because students learn not only theoretically but also through hands-on practice involving various skills (Prastiwi & Yulianto, 2024).

Furthermore, high levels of learning activity also contribute to improved learning outcomes. (Nurhasnah dkk., 2023) stated that students who are active in learning tend to have a better understanding of the material. Thus, it can be concluded that the implementation of the Project-Based Learning model integrated with STEAM not only enhances learning activities but also significantly impacts student learning outcomes. This model provides meaningful learning experiences, enabling students to understand the material more deeply and apply it effectively (Hidayati dkk., 2023).

CONCLUSION

Based on the results of data analysis, hypothesis testing, and discussion, it can be concluded that the implementation of the STEAM-integrated Project Based Learning model has a positive and significant impact on student learning activities and outcomes. The implementation of this model has been proven to improve science learning activities on the topic "My Region, My Pride" among fifth-grade students at SDN Sukun 1, Malang City, as demonstrated by increased student engagement in the learning process.

Furthermore, the implementation of the STEAM-integrated Project Based Learning model has also proven effective in improving student learning outcomes, as evidenced by the increase in post-lesson grades. Therefore, this learning model can be used as an innovative and effective alternative to improve the quality of science learning in elementary schools.

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