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The Effect of STEAM-Based Project Learning on Junior High School Students' Collaboration Skills

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ABSTRACT
This study aims to determine the effect of the STEAM (Science, Technology, Engineering, Art, and Mathematics) approach on the collaboration skills of junior high school students. The study employed a true experimental method with a Posttest-Only Control Group Design. The research population consisted of all 148 seventh-grade students of SMP Negeri 18 Palu in the 2023/2024 academic year. Sampling was conducted using a purposive sampling technique based on specific considerations from the physics teachers at SMP Negeri 18 Palu. Class VII A was designated as the experimental group that implemented the STEAM (Science, Technology, Engineering, Art, and Mathematics) approach within the Project Based Learning (PjBL) model, while Class VII B served as the control group using the scientific approach in PjBL. The instrument used was a collaboration skills observation sheet consisting of four assessment indicators. The results of data analysis using the Independent Sample t-test revealed a significant difference between the experimental and control groups, with a Sig. (2-tailed) value of 0.004 < 0.05. These findings indicate that the STEAM (Science, Technology, Engineering, Art, and Mathematics) approach has a significant effect on students' collaboration skills. Therefore, the implementation of STEAM-based learning is an effective alternative for enhancing students' collaboration skills in science learning at the junior high school level. Furthermore, these findings confirm that the STEAM approach is not only relevant for integrating multiple disciplines but also contributes significantly to the development of 21st-century collaboration skills, thereby strengthening and extending previous studies that primarily focused on improving students' learning outcomes and creativity.

INTRODUCTION

The 21st-century education requires students to possess skills that match the demands of the modern era, such as critical thinking, collaboration, and problem-solving in real-life situations. These challenges arise due to rapid technological development and the increasingly complex needs of the globalized world [1]. In Indonesia, efforts to address these challenges are carried out through the implementation of the 2013 Curriculum, which emphasizes the development of 21st-century skills. One essential skill that students must have is collaboration, which refers to the ability to work together with others to achieve common goals [2].

Collaboration skills are part of the 21st-century competencies, alongside critical thinking, creativity, and communication [3]. Collaboration involves more than just working together; it includes task division, respecting others' opinions, and shared responsibility for group outcomes [4]. However, in practice, students' collaboration skills are still not fully developed because classroom learning is often teacher-centered and individual-based.

Interviews with seventh-grade physics teachers at SMP Negeri 18 Palu revealed that students' collaboration skills are still relatively low, especially in physics learning. Students tend to work individually and participate less in group discussions. This situation indicates a gap between the curriculum goals and classroom practices. Similar findings have also been reported in several studies in Indonesian junior high schools, showing that students still face challenges in working effectively together.

To address these issues, learning approaches that actively encourage student collaboration are needed. One promising approach is STEAM (Science, Technology, Engineering, Art, and Mathematics) education [5]. The STEAM approach integrates multiple disciplines and engages students in project-based activities to solve real-world problems [6]. Through these activities, students are trained to discuss, share ideas, and collaborate in groups [7].

Several studies have indicated that STEAM-based learning can enhance students' collaboration, creativity, and problem-solving skills. However, research specifically examining the effect of the STEAM approach on collaboration skills among junior high school students, particularly in the Indonesian context, remains limited. Therefore, this study was conducted to investigate the effect of implementing the STEAM approach through the Project-Based Learning (PjBL) model on students' collaboration skills in science learning.

METHOD

This study employed a quasi-experimental design with a Posttest-Only Control Group approach to examine the effect of the STEAM (Science, Technology, Engineering, Art, and Mathematics) approach on students' collaboration skills. The research population consisted of 148 seventh-grade students at SMP Negeri 18 Palu in the 2023/2024 academic year. The sample was selected using a purposive sampling technique based on the recommendations of the physics teachers. Class VII A was designated as the experimental class that implemented the STEAM approach through the Project-Based Learning (PjBL) model, while Class VII B served as the control class taught using a scientific approach.

The research instrument was a collaboration skills observation sheet consisting of four indicators: (1) working productively in groups, (2) actively participating, (3) being responsible for group assignments, and (4) respecting the opinions of group members. The instrument's content validity was assessed through expert judgment, and inter-rater reliability was calculated to ensure consistency among observers.

The collected data were analyzed using the Shapiro-Wilk test for normality, Levene's test for homogeneity, and the Independent Sample t-test to determine differences between the experimental and control groups. All analyses were performed using SPSS software version 23.

RESULTS AND DISCUSSIONS

The observation results showing that the experimental class scored higher on collaboration skills (14.15) compared to the control class (13.38) indicate that the STEAM approach effectively supports the development of collaborative abilities. One reason STEAM enhances collaboration is that it emphasizes project-based activities requiring group interaction, idea sharing, and coordinated problem solving. STEAM learning tasks are typically open-ended and multidisciplinary, compelling students to communicate, negotiate roles, and divide responsibilities to complete authentic projects, which naturally fosters collaborative behavior [8].

This finding aligns with social constructivist theory, which posits that cognitive development occurs through social interaction and shared meaning making. In a STEAM PjBL environment, students construct knowledge together through meaningful tasks and peer discussions rather than passively receiving information [9]. The collaborative nature of STEAM projects mirrors the principles of collaborative learning, where learners co-create understanding, support mutual learning, and reflect on each other's thinking, deepening both conceptual understanding and social skills [10]. Recent implementations of STEAM have demonstrated that such integrative learning conditions not only promote collaboration but also strengthen other 21st-century competencies such as critical thinking and creative problem solving.

The added value of this study lies in providing empirical evidence that STEAM improves collaboration skills in a junior high school context, a level where most existing research still focuses on elementary settings or on cognitive outcomes (e.g., creativity, interest, or motivation). While many recent studies report STEAM's positive effects on engagement and interdisciplinary learning, there is limited quantitative research that specifically measures collaboration skills in secondary school science learning. This study fills that gap by demonstrating that STEAM, when coupled with Project-Based Learning, can effectively bridge the gap between curriculum expectations and students' collaborative competence, reinforcing STEAM's potential as a comprehensive pedagogical approach for modern education.

CONCLUSION AND SUGGESTION

Based on the results of the Independent Sample t-test, the STEAM approach significantly influenced the improvement of junior high school students' collaboration skills in science learning, with a significance value of $0.004 < 0.05$. This indicates that

students who participated in STEAM-based learning exhibited better collaborative abilities compared to those who learned using a scientific approach. Therefore, the STEAM approach can be used as an alternative learning strategy that effectively fosters collaboration among students.

However, this study has several limitations that should be considered. First, the research was conducted in a single school with only seventh-grade students, which may limit the generalizability of the findings to other schools or grade levels. Second, the study focused solely on collaboration skills and did not examine other 21st-century competencies such as critical thinking, creativity, or communication in depth. Future research could expand the scope by including multiple schools, different grade levels, and a broader range of 21st-century skills. Additionally, longitudinal studies could investigate the long-term effects of STEAM-based learning on students' collaborative abilities and other soft skills, providing a more comprehensive understanding of its educational impact.

REFERENCES

[1] OECD, OECD Future of Education and Skills 2030. Paris, France: OECD Publishing, 2019.

[2] B. Trilling and C. Fadel, 21st Century Skills: Learning for Life in Our Times. San Francisco, CA, USA: Jossey-Bass, 2009.

[3] C. Lemke, enGauge 21st Century Skills: Digital Literacies for a Digital Age. Naperville, IL, USA: North Central Regional Education Laboratory, 2003.

[4] L. Greenstein, Assessing 21st Century Skills: A Guide to Evaluating Mastery and Authentic Learning. Thousand Oaks, CA, USA: Corwin Press, 2012.

[5] S. Hafsah, M. Hendri, and D. P. Rasmi, "Pengembangan modul ajar terintegrasi STEAM PjBL untuk meningkatkan kemampuan berkolaborasi pada materi kesetimbangan benda tegar," JIIP – Jurnal Ilmiah Ilmu Pendidikan, vol. 8, no. 7, pp. 8649–8656, 2025, doi: https://doi.org/10.54371/jiip.v8i7.8721

[6] G. Yakman, "STEAM education: An overview of creating a model of integrative education," in Proc. Purdue University Conf., West Lafayette, IN, USA, 2008.

[7] S. D. Indahwati, F. Rachmadiarti, and E. Hariyono, "Integration of PJBL, STEAM, and learning tool development in improving students' critical thinking skills," Int. J. Recent Educ. Res., vol. 4, no. 6, pp. 808–818, 2023, doi: https://doi.org/10.46245/ijorer.v4i6.434

[8] D. Handayani and N. Nurhamidah, "The development of student soft skills through the integration of PJBL STEAM learning in the organic chemistry 1 topic of hydrocarbons," Jurnal Pendidikan Kimia Indonesia, vol. 8, no. 1, 2023, doi: https://doi.org/10.23887/jpki.v8i1.71120

[9] W. Sumarni, S. S. Sumarti, S. H. Dewi, and M. Imaduddin, "Collaborative Ethno STEAM enriched project based learning (CoE STEAM PjBL): Its impact on prospective science teachers' collaboration and creative thinking skills," Jurnal Pendidikan IPA Indonesia, vol. 14, no. 3, 2025, doi: https://doi.org/10.15294/jpii.v14i3.25487

[10] S. Suryaningsih, S. Agung, H. D. Barke, and F. A. Nisa, "Building 21st century skills with STEAM PjBL," Edusains, vol. 16, no. 2, 2024, doi: https://doi.org/10.15408/es.v16i2.41779