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Implementing a STEAM-Integrated Project-Based Learning Model with Ecoprint Techniques to Empower Students' Collaborative Skills

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Abstract

This study aims to describe students' collaboration skills in science learning based on Project-Based Learning (PjBL) integrated with STEAM with ecoprint techniques. The research method used is descriptive quantitative with a population of 6th-grade students from one of the Elementary schools in Serang. Data were obtained through observations of 12 indicators of collaboration skills covering aspects of participation, communication, teamwork, and problem solving, then analyzed descriptively. The results showed that students' overall collaboration skills were in the very high category, with an average score of 83.3% and 81% of students were in the very good category. This indicates that the implementation of the PjBL STEAM ecoprint model successfully empowered students' collaboration skills in completing projects involving effective interaction and task division. The responsibility aspect showed the highest score (85.88%). This study makes an important contribution to the development of 21st-century learning that emphasizes collaboration as a core competency.

Keywords: Collaboration skills, Project-Based Learning, STEAM, ecoprint.

INTRODUCTION

Rapid technological developments have significantly impacted the field of education. Technology has become a key catalyst in transforming education from a conventional approach to a more interactive, collaborative, and contextual one. Technology also enriches learning methods. Students can learn through videos, interactive simulations, and engaging animations using multimedia (Rusdianah et al., 2025). Easy access to information and various online learning platforms also enables students to effectively develop a variety of essential skills. Digital media, internet access, and technology-based learning tools enable students to quickly access information, conduct independent exploration, and collaborate (Yunita & Sutabri, 2024).

Along with technological advances, the demands on students' skills have also changed. 21st-century education emphasizes mastery of critical thinking, creativity, communication, and collaboration (the 4Cs) to prepare students to face dynamic and complex global challenges. Collaboration skills are a key aspect developed through 21st-century education due to their role in shaping students' ability to work in teams, convey ideas, and solve problems effectively (Hapsari & Prasetyarini, 2025).

Collaboration skills are students' abilities to work together in groups, integrating diverse perspectives and knowledge, and actively participating in discussions by providing feedback, listening, and supporting one another (Anggraini et al., 2024). Collaboration skills can also be

defined as students' ability to work together by interacting, exchanging opinions, and respecting each individual's contribution in solving problems and achieving common goals (Sarifah & Nurita, 2023).

Collaboration skills play various important roles for students to face challenges in education and work (Adiansyah et al., 2024). These skills enable students to interact effectively in groups, share ideas, align perspectives, and collaborate on assignments or projects (Rafifah, 2023). Furthermore, collaboration skills support the development of problem-solving and critical thinking skills, creativity, and effective communication between individuals. All of these skills are highly useful in daily life and the learning process (Sarifah & Nurita, 2023). Collaboration also supports the development of empathy, mutual respect for differences, personal responsibility, and flexibility in working together (Hapsari & Prasetyarini, 2025). These skills are essential because the characteristics of today's work world and social life require people to be able to adapt in a multicultural environment that is interconnected and complex.

Collaboration is not just a simple collaborative activity; it also encompasses the ability to interact, communicate, and actively contribute within a team to achieve common goals effectively and productively. Therefore, developing collaborative skills is a crucial component in preparing students to face the challenges of life in the 21st century (Purnomo et al., 2024). Therefore, schools and teachers are faced with the educational challenge of designing approaches, methods, and learning models that can foster collaborative skills systematically and contextually, enabling students to survive and excel in the era of Society 5.0.

One learning model that can support students' collaborative skills is project-based learning (PjBL). The PjBL model can develop students' collaborative skills because it requires students to work together to complete projects (Purnomo et al., 2024). PjBL places students at the center of projects that are carried out over a specific period to produce individual or group products (Anggraini et al., 2024). PjBL enables students to work in groups and communicate effectively (Miao et al., 2024).

Implementation of project-based learning can be integrated with STEAM, an approach that incorporates elements of art and technology into education and science. STEAM education and its processes seem neutral to humanity or inhumanity, and it focuses on individual and group-benefit through the exploitation of resources, including humans and nature (Belbase et al., 2022). The integration of project-based learning with STEAM elements demonstrates strong alignment with the competencies needed in the 21st century (Irdalisa et al., 2024b). STEAM-integrated PjBL can be implemented, among other things, through ecoprinting activities.

Ecoprinting is a technique for printing motifs using natural materials such as leaves and flowers. Several studies have shown that ecoprinting can be used as an innovative and sustainable learning medium for elementary education (Sinto & Santi, 2025).

Ecoprinting techniques introduce concepts of biology and environmental sustainability and provide students with opportunities to develop creativity and collaborative skills. Ecoprinting projects allow students to directly interact with nature, understand the function of plants as a source of natural materials, and hone their artistic and teamwork skills. During the activity, students were not only taught ecoprint techniques but also given an understanding of the importance of preserving the environment (Apriyanti et al., 2024). This technique not only produces aesthetically pleasing, environmentally friendly products but also fosters students' appreciation for the beauty of nature (Nurseha et al., 2024). Ecoprint can also assist students in studying topics related to the plant kingdom that employ uncomplicated and user-friendly tools (Irdalisa et al., 2024b). The ecoprint technique is a form of biodiversity utilization (Aji et al., 2023). In an educational context, ecoprinting can be applied as a STEAM-integrated project-based learning technique that encourages creativity, collaboration, and ecological understanding in students (Kurniawati et al., 2025). STEAM-based worksheets in conjunction with the ecoprint method to foster students' motivation and creativity, as ecoprint inherently encompasses all STEAM components within the manufacturing process (Irdalisa et al., 2024).

Several previous studies have explored the use of ecoprinting projects in art and creativity learning contexts, as well as their benefits in enhancing artistic skills and environmental awareness. These studies generally found ecoprinting to be effective in facilitating a fun and contextual learning process. Ecoprinting has also been shown to enhance student creativity (Sinto & Santi, 2025). However, studies specifically examining the development of students' collaborative skills in ecoprinting projects are still very limited. Most research focuses primarily on creativity and the resulting artistic products, without delving into how student collaboration develops and develops during the project (Irdalisa et al., 2024). This shortcoming highlights the need for more focused research analyzing students' collaboration skills in the context of ecoprint implementation, particularly at the elementary school level.

The implementation of a STEAM-based ecoprint project-based learning model (PjBL) as an effort to improve students' collaboration skills is crucial for systematically analyzing the collaborative skills developed through ecoprint projects. This research is expected to contribute to the theory and practice of 21st-century learning, which emphasizes collaboration as a core competency. Therefore, this study aims to describe students' collaboration skills through learning using a STEAM-integrated project-based model with the Ecoprint technique.

METHOD

The research method used was descriptive quantitative. This study aims to describe students' collaboration skills in science learning using the STEAM Ecoprint-based Project-Based Learning model. The population in this study was students of one of the Elementary schools, with a sample of 6th-grade students. The sample was selected using purposive sampling, a sampling technique with specific considerations (Machali, 2021)

Data collection was conducted using a non-test technique, namely through observations of indicators of students' collaboration skills during science learning using the STEAM Ecoprint-based Project-Based Learning model. The implementation of STEAM Ecoprint-based Project-Based Learning (PjBL) integrates learning with science, technology, engineering, art, and mathematics through an ecoprint project. During the ecoprint-making process, students work on the ecoprint-making project together with their group members. Collaborative skills are evident as students complete the stages of ecoprint-making. The research instrument used was a collaboration skills observation sheet consisting of 12 indicators. Students' collaboration skills will be assessed based on four aspects of collaboration: participation or contribution, communication or perspective-taking, teamwork or group task regulation, and problem-solving (conflict resolution). Each aspect is represented by three indicators.

The data obtained from the observations will then be analyzed using descriptive statistics with the formula:

$$\% = \frac{n}{N} \text{ x } 100$$

Description:

%: Percentage value

N: Value obtained

N.: Maximum value

100: Constant

The calculated values for collaboration skills will be interpreted as very high, high, medium, low, and very low (Table 1):

Table 1. Student Collaboration Skills Categories

Percentage (%)	Criteria
81- 100	Very high
61- 80	High
41- 60	Medium
21- 40	Low
0- 20	Very low

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RESULTS AND DISCUSSION

The STEAM Ecoprint-integrated PjBL model was implemented at Cipocok Jaya Public Elementary School, Serang City. The PjBL model began with the teacher presenting a basic problem-solving question related to the environmental hazards of clothing dye waste (Figure 1a). In the next stage, students created a project design that included objectives and implementation stages. Students then discussed and developed a project schedule or timeline. STEAM (Science, Technology, Engineering, Art, and Mathematics) components were incorporated into the ecoprint project materials and activities to ensure innovative and interdisciplinary learning, while also providing students with opportunities to optimally develop their collaborative skills.

a b

Figure 1. Students listen to the teacher's delivery of basic questions (1a). Students discuss the project design and project implementation schedule (1b).

Students then carried out an ecoprint product creation project with their group members (Figure 2). During the project, students collaborated to achieve a common goal: producing an ecoprint product. Collaboration enables individuals and groups to work together to achieve a common goal through the exchange of ideas, shared use of resources, and equitable sharing of responsibilities .

Figure 2. Students carried out an ecoprint product creation project with their group members

The final products of the STEAM Ecoprint-integrated PjBL phase were a tote bag and a tablecloth with leaf motifs from various plant species (Figure 3).

Figure 3. Students display the Ecoprint products they have produced.

Figure 4 shows that elementary school students' collaborative skills in the Ecoprint project-based learning were generally in the excellent category, with an average score of 83.3. Most (81%) students were in the excellent category. However, no students were found in the low category. The results of data analysis showed that 81% of the 21 students had collaborative skills in the excellent category. This finding indicates that students are able to collaborate with their group members in completing ecoprint projects. Individuals with high levels of collaborative skills tend to demonstrate better abilities in establishing teamwork, expressing ideas constructively, and resolving conflicts that arise during the collaborative process (Eliaumra et al., 2023).

The application of the STEAM-integrated PjBL model with the ecoprint technique can empower students' collaborative skills in various educational contexts. The results of research by Irdalisa et al. (2024) showed that the application of STEAM-based PjBL with the ecoprint technique significantly influenced students' achievement in scientific thinking skills and creativity, and increased students' active involvement in collaborative projects that integrate STEAM elements. The study also concluded that the use of innovative learning media, such as ecoprint, can facilitate more contextual and collaborative learning. These findings are in line with the statement of Purnomo et al. (2024) that PjBL is effective in enhancing students' collaborative skills and can be integrated into the elementary school curriculum to promote these essential abilities. In addition, the research results of Irdalisa et al. (2024) also confirmed that the implementation of PjBL with the ecoprint technique significantly increased students' learning motivation and creativity, and supported the development of collaborative skills through the analysis of STEAM-based worksheets.

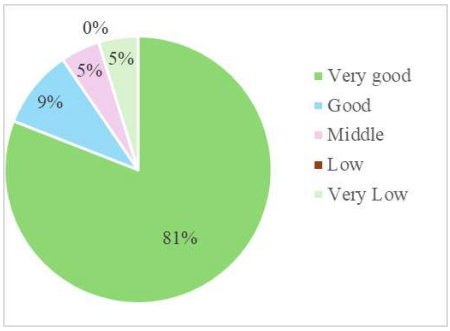

Figure 4. Distribution of students in each collaboration skills category

The teamwork aspect showed the highest score compared to other collaborative skill aspects, with an average score of 96.8%. The high score was achieved in the teamwork aspect because the PjBL model places students at the center of learning, so that each group member must actively contribute to the project's completion. Constructivist theory emphasizes that students build knowledge through direct experience and active interaction, so participation is the main key in collaborative learning. The findings of this study are not in line with those of previous research, which showed that the responsibility aspect achieved an average percentage of 85.88%. This means that students are able to take responsibility by completing work on time, actively contributing to group activities, and seeking resources to solve problems (Sarifah & Nurita, 2023).

The communication/perspective-taking aspect showed the lowest score compared to other collaborative skill aspects (Figure 5). The low communication/perspective-taking aspect indicates that students are less skilled in communicating because there are still students who tend not to express their opinions and simply agree with the opinions of their friends. The findings of this study are not in line with the statement of Sarifah & Nurita (2023) that the low score for communication is also due to the fact that some students are still unable to accept the opinions of their groupmates. Students with high intellectual abilities tend to look down on students with lower abilities.

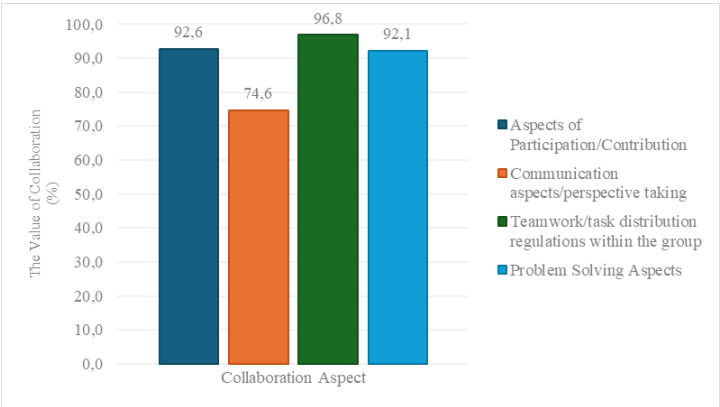

Figure 5. Student scores on each aspect of collaboration skills

CONCLUSION

The implementation of the Project-Based Learning model, integrated with STEAM and using the ecoprint technique, was effective in improving elementary school students' collaboration skills. Students were able to work optimally in teams, communicate, and solve problems during the ecoprint project. These strong collaboration skills support the development of creativity, responsibility, and appreciation for the environment. Therefore, this learning model is recommended as an innovative and contextual approach to improving students' readiness to face global challenges and the Society 5.0 era.

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