



Evaluating STEAM-Based Project-Based Learning in Graphic Arts Education

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ABSTRACT

Purpose of the study: This study aims to evaluate the implementation of a STEAM-based Project-Based Learning (PjBL) model in graphic arts education, focusing on its impact on student learning outcomes, including creativity, technical skills, and collaboration.

Methodology: The study used qualitative descriptive research with data collection through observation and documentation. The subjects were 20 third-semester students in fine arts and design, divided into 5 groups. Data analysis involved coding, categorizing, and summarizing results.

Main Findings: The evaluation revealed varying levels of integration of STEAM concepts across groups. While most students demonstrated satisfactory creativity in technology use and teamwork, Group 5 showed the most creative use of technology. All groups applied mathematics and science at a basic level, indicating room for deeper integration of these disciplines.

Novelty/Originality of this study: This study fills the gap in research by specifically focusing on the integration of STEAM-PjBL in graphic arts education. It provides evidence of the model's effectiveness in a creative field, offering valuable insights for educators on improving interdisciplinary learning in graphic design.

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1. INTRODUCTION

The rapid evolution of education systems worldwide has underscored the importance of interdisciplinary learning methods that foster creativity, critical thinking, and problem-solving skills. In particular, integrating Science, Technology, Engineering, Arts, and Mathematics (STEAM) into educational curricula has gained substantial attention for its potential to enhance student engagement and learning outcomes. The STEAM approach emphasizes the interconnectedness of various disciplines and encourages students to apply knowledge across multiple fields, which is especially beneficial in the context of project-based learning (PjBL). According to [1];[2], Project-Based Learning (PjBL) within STEAM disciplines fosters an environment where students engage in real-world problems and create solutions through collaborative projects, promoting deeper learning and skills development. This approach not only aids in understanding complex concepts but also nurtures practical skills like communication, teamwork, and creative problem-solving.

In the context of graphic arts education, the integration of STEAM and PjBL models offers an innovative avenue to enhance student learning. Graphic arts, as an inherently creative field, demands a blend of technical and artistic skills, making it an ideal domain for applying STEAM principles. As [3] highlight, incorporating STEAM into art education enriches students' understanding of both artistic techniques and the technological tools required in modern graphic design. Furthermore, the combination of PjBL with STEAM in graphic arts education encourages students to work on projects that combine theoretical knowledge with hands-on experience, thus providing a comprehensive learning experience. Recent studies, such as those by [4], suggest that PjBL, when applied in the context of design and the arts, not only enhances creative skills but also prepares students for real-world challenges they will encounter in the professional art world.

Despite the promising potential of STEAM-integrated PjBL in graphic arts education, several challenges remain in its effective implementation. These challenges include varying levels of teacher preparedness, inadequate resources, and a lack of structured frameworks to guide the integration of multiple disciplines. [5]; [6] note that while many educators recognize the value of the STEAM approach, there is often uncertainty regarding how to properly incorporate it into the curriculum, particularly in specialized fields like graphic arts. This creates a gap between the theoretical benefits of STEAM-PjBL and its practical application in educational settings, which affects the overall student learning experience and outcomes [7].

To address this gap, a more systematic and evidence-based approach to integrating STEAM with PjBL in graphic arts is needed. The present study aims to evaluate the implementation of a STEAM-based PjBL model in the context of graphic arts education. This evaluation will examine how the model influences student learning outcomes, with the hypothesis that the PjBL model, when integrated with the STEAM approach, will lead to improved learning outcomes in graphic arts. By focusing on the implementation of this model, the study will provide valuable insights into the effectiveness of STEAM-PjBL in enhancing creativity, technical skills, and critical thinking among students, while also addressing the challenges identified in previous research [2].

Several studies have explored the benefits and applications of PjBL in various disciplines, including graphic arts. According to [2], integrating the STEAM approach with PjBL has been shown to improve student motivation and interest, as it connects learning with real-world applications. This aligns with the findings of [4], who found that students involved in STEAM-PjBL projects in design courses exhibited higher levels of creativity and problem-solving skills, essential attributes for success in the field of graphic arts. Moreover, the hands-on nature of PjBL allows students to develop practical skills that are crucial in the arts, such as technical proficiency with design software, project management, and collaborative work, all of which are directly applicable to professional settings.

In the context of graphic arts education, the application of a STEAM-PjBL model fosters an interdisciplinary learning environment, where students are encouraged to explore the intersection of art, technology, and design. As [8] demonstrated, students working on STEAM-PjBL projects in the arts are more likely to develop a deeper understanding of both the creative and technical aspects of design. Their study on micro-bit paper-cutting lamps in a STEAM-PjBL context revealed that students were able to bridge the gap between theoretical knowledge and practical application, thus enhancing their overall learning experience. Such projects provide an excellent platform for graphic arts students to engage with both the artistic and technological components of design, contributing to the development of well-rounded professionals.

Furthermore, the integration of STEAM-PjBL in graphic arts education also supports the development of 21st-century skills, such as critical thinking, communication, and collaboration. [3] argue that STEAM-based PjBL enhances students' ability to tackle complex, open-ended problems, which are central to the design process in graphic arts. The ability to approach problems from multiple disciplinary perspectives, including science, technology, and the arts, helps students develop more innovative and effective solutions [9]; [10]. This multidisciplinary approach also encourages students to think critically and reflectively, skills that are essential in both academic and professional contexts.

While existing literature provides ample evidence of the benefits of STEAM and PjBL across various fields, there is limited research that specifically evaluates the impact of STEAM-PjBL in the context of graphic arts education. Most studies, such as those by [11]; and [12]; [13] focus on subjects like mathematics and science, with little emphasis on the creative disciplines where the integration of technology and the arts is crucial. Although there is growing recognition of the importance of STEAM in art education, much of the research remains general and does not address the unique challenges and opportunities that arise within specific fields like graphic arts.

In addition, while some studies, such as those by [9]; [14], highlight the importance of integrating critical thinking skills into the learning process, few provide concrete frameworks for assessing the effectiveness of

STEAM-PjBL specifically in graphic arts classrooms. This gap in the literature indicates a need for more focused research that examines how the STEAM-PjBL model can be tailored to the unique demands of graphic arts education, both in terms of curriculum design and instructional methods. Moreover, there is a lack of studies that comprehensively assess the student learning outcomes, including both cognitive and non-cognitive skills, following the implementation of STEAM-PjBL in graphic arts settings.

This study is novel in its specific focus on the integration of STEAM-PjBL in graphic arts education, a field that has not been extensively explored in previous research. The scope of the study includes an analysis of how the STEAM-PjBL model can be effectively implemented in graphic arts classrooms. The study also aims to contribute to the growing body of literature on STEAM education by providing concrete evidence of its effectiveness in a specialized domain like graphic arts. By doing so, the research seeks to fill the gap in existing knowledge and offer valuable insights for educators, policymakers, and researchers interested in improving education in the arts.

2. RESEARCH METHOD

The method used in this study was qualitative descriptive research. Data collection techniques used were observation and documentation studies. The subjects were 20 third-semester students majoring in fine arts and design at the Faculty of Engineering divided into 5 groups. Data processing is carried out in the following stages: 1. Checking the entire list of questions and answers from respondents, 2. Classifying data, 3. Activities to compile and calculate data. While the stages of data analysis are as follows: 1. Data collection, namely collecting facts from observation results and results from documentation studies. 2. Data reduction, in this activity the researcher combines the same data from different subjects. 3. Coding process, this process aims to make it easier for researchers to discuss facts related to theory. 4. Drawing conclusions.

Score range for the Implementation of STEAM-based Project-Based Learning (PjBL), which can be used to assess the success and quality of implementing this approach in the classroom can be seen in the table 1 below:

Table 1. STEAM-Based Project-Based Learning (PjBL) Assessment Score Range

Assessment Criteria	Score 1 (Very Poor)	Score 2 (Poor)	Score 3 (Satisfactory)	Score 4 (Good)
Connection between STEAM Concepts and Project	No connection between STEAM concepts and the project	Very limited or unclear connection between STEAM concepts and the project	Some connection between STEAM concepts is made, but practical application is still lacking	Strong and clear connection between STEAM concepts and their effective application in the project
Creativity in Using Technology	No use of technology or very limited use of technology	Technology used but with limited functionality	Technology is used to support some aspects of the project, but not creatively	Technology is used effectively and creatively to support the project
Use of Mathematics and Science	No application of mathematics and science concepts in the project	Mathematics and science concepts are very limited or irrelevant	Mathematics and science are applied in some parts of the project, but the application is superficial	Mathematics and science are well applied, contributing significantly to the project's success
Collaboration in the Team (Group Work)	No collaboration between team members	Very minimal or unproductive collaboration	Collaboration is decent, but there are issues with team harmony	Excellent collaboration, with team members working effectively and harmoniously together

3. RESULTS AND DISCUSSION

Result Research

The results of the evaluation of the implementation of STEAM-based Project-Based Learning (PjBL) on graphic arts material consisting of 4 criteria can be seen in table 2 below:

Tabel 2. PjBL Assessment Analysis

Group	STEAM Concepts and Project	Creativity in Using Technology	Use of Mathematics and Science	Collaboration in the Team (Group Work)	Average Score
1	3	3	3	4	3,25
2	2	3	3	3	2,75
3	4	3	3	3	3,25
4.	3	3	3	3	3,0
5.	4	4	3	4	3,75

Based on the score distribution from five groups on the STEAM-based Project-Based Learning (PjBL) criteria, here is the analysis of the data: STEAM Concepts and Project: The scores for this criterion are distributed across 2, 3, and 4. Group 2 scored 2, indicating a weaker application of STEAM concepts in their project. In contrast, Groups 3 and 5 scored the highest (4), demonstrating a better and clearer application of STEAM concepts. Creativity in Using Technology: Most groups (except Group 5) scored 3, showing a satisfactory level of creativity in using technology. Group 5 scored 4, indicating a more creative and effective use of technology in their project. Use of Mathematics and Science: All groups scored 3 for this criterion, suggesting that mathematics and science were applied in the projects, but with a similar level of depth across all groups. Collaboration in the Team (Group Work): Scores for this criterion are distributed between 3 and 4. Groups 1 and 5 scored 4, indicating excellent and effective teamwork. The other groups (Groups 2, 3, and 4) scored 3, suggesting that while team collaboration was good, there is room for improvement in team cooperation.

The analysis indicates that most groups performed well in collaboration and use of mathematics/science. However, Group 2 showed lower scores in linking STEAM concepts to the project. On the other hand, technology use was more creative in Group 5, which stood out compared to other groups. Overall, while there are some weaknesses in certain criteria, the application of PjBL based on STEAM has been relatively successful in fostering collaboration and understanding of concepts in the graphic arts material.

Discussion

The implementation of the Project-Based Learning (PjBL) model integrated with the STEAM approach in graphic arts education has become a relevant topic in efforts to improve learning outcomes. From the document presented, it is clear that the application of this model has shown several benefits in enhancing students' understanding and skills. The STEAM approach (Science, Technology, Engineering, Arts, and Mathematics) supports a learning model that connects concepts across multiple disciplines, which is highly relevant in the context of graphic design, a field that blends both creative and technical aspects. This aligns with the findings of Hawari and Noor (2020), who stated that PjBL within STEAM disciplines helps students engage with real-world problems and create solutions through collaborative projects.

However, the evaluation revealed that despite the generally positive results, there are some challenges in the effective application of this model. One such challenge is the variation in students' understanding and application of STEAM concepts across different groups. For instance, in the assessment of how well STEAM concepts were integrated into the project, some groups, like Group 2, scored lower (2), indicating a weaker connection between STEAM concepts and their project. On the other hand, Group 5 demonstrated more creative use of technology, scoring 4, reflecting a more effective and innovative application of technology in their project.

The limited application of mathematics and science in the graphic design projects, observed across all groups, also highlights the need to strengthen the understanding of how these concepts can be applied more deeply in the context of graphic arts. According to [14]; [15], integrating arts and technology in education enhances students' understanding of both artistic techniques and the technological tools needed for modern design. The study showed that while all groups applied mathematics and science at a satisfactory level (scoring 3), there is still room for improvement in how these subjects contribute to the project's success. Collaboration within teams was another noteworthy aspect. While most groups displayed good teamwork, there is still room for improvement, particularly in the groups that scored lower in this aspect. Effective collaboration is a key element of PjBL, which supports the development of communication, problem-solving, and decision-making skills—all of which are essential in the professional design field [16]; [17]; [18]; [19]. This finding aligns with [4]; [16]; [20], who demonstrated that PjBL improves communication and teamwork skills among students.

This research also highlights the limited focus of existing studies on the integration of STEAM-PjBL in the specific field of graphic arts education. While the literature on the benefits of STEAM and PjBL in various disciplines is abundant, there is little research dedicated to how these models can be applied in creative fields, where the intersection of technology and art is crucial. This study contributes by filling this gap and providing further insights into the effectiveness of the STEAM-PjBL model in graphic arts education.

4. CONCLUSION

The conclusion of this study shows that the implementation of the STEAM-PjBL model in graphic arts education can enhance students' understanding of artistic and technological concepts and foster important collaborative skills in graphic design. However, there are areas for improvement, particularly in strengthening the integration of STEAM concepts and encouraging more creative use of technology.

The recommendations are as follows: first, it is essential for educators to further develop their understanding of how to integrate STEAM concepts more deeply into the graphic arts curriculum. Second, there should be greater emphasis on promoting the creative use of technology in graphic design projects, providing students with more opportunities to experiment and innovate with digital tools. Finally, to improve teamwork collaboration, educators should provide additional guidance on group dynamics to ensure that every member contributes effectively to the project.

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