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The Effect of STEM-PJBL Model on Students' Creative Thinking Skills

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Abstract

Creative thinking is one of the essential 21st-century skills required to respond to rapid global change. The STEM-PjBL (Science, Technology, Engineering, and Mathematics–Project-Based Learning) model integrates project-based learning with STEM principles, thereby fostering students' creativity and interdisciplinary understanding. This qualitative literature review analyzed 14 research articles selected through purposive sampling using Google Scholar, with inclusion criteria focusing on studies examining the influence of STEM-PjBL on creative thinking. The review findings consistently indicate that STEM-PjBL enhances students' ability to generate ideas, solve problems, and engage in higher-order thinking processes. These results confirm that STEM-PjBL is an effective instructional model to strengthen creative thinking as a 21st-century competence.

Keywords: Creative Thinking Skills,Literature Review, STEM-PJBL

Introduction

The 21st century is upon us, a century marked by swift advancements in science and technology worldwide. Globalization has resulted from the rising competitiveness between nations. 21st-century skills are new abilities required to compete in the 21st century (Kristiani et al., 2017). Education can help acquire 21st-century abilities. With the help of technology, educators and students can improve their social and professional lives in the future. The 4Cs—critical thinking, communication, teamwork, and creativity—are the abilities that are taught (Kristiani et al., 2017). The four 21st-century competencies of critical thinking, communication, teamwork, and creativity are together referred to as the "4Cs."

These skills are taught to students during their education. Education is essential for every human being. The rapid development of human civilization is inextricably linked to the role of education. Without education, humans would not grow and develop properly. Education is an effort to shape human character, enabling them to grow and develop into beings with advantages over other creatures. To become a person with all these advantages, education is necessary to develop knowledge and skills. Knowledge and skills are essential for human survival (Sukmawijaya et al., 2019).

STEM (Science, Technology, Engineering, and Mathematics) education is one method that can help students develop their capacity for innovative thought throughout the epidemic. Numerous cutting-edge learning models, including inquiry-based learning, problem-based learning (PBL), and project-based learning (PjBL), can be used to apply STEM as an approach. The PjBL learning model is a cutting-edge approach to education that can be integrated with STEM.This is because the syntax in PjBL is aligned with STEM. PjBL learning syntax includes the engineering process, which is part of the STEM approach, so both support each other in achieving students' creative thinking. Because STEM-PjBL requires students to solve problems creatively through the creation of a product, it can foster student creativity. According to Karlina et al. (2023), there are five stages of STEM-PjBL: reflection, investigation, discovery, application, and communication. According to research by Ningrum et al. (2021), STEM-based PjBL instruction can enhance students' conceptual understanding and inventiveness. According to Karlina et al. (2023), STEM-PJBL education must be able to address a number of 21st-century issues, including addressing climate change in line with the Sustainable Development Goals (SDG).

Creative thinking is the capacity to overcome problems and generate something novel or distinct.Pupils who employ creative thinking are able to view the world from various perspectives and provide novel solutions to issues that arise in daily life. Critical thinking is also a cognitive process that recognizes a problem, finds a solution, and then provides a logically processed conclusion or consideration to address the issue. As a result, critical thinking abilities are crucial for improving cognitive function and efficiently storing information. This is done to produce a generation of the nation that is in accordance with the demands of the 21st century. One learning pattern that can be used is the application of STEAM (Science, Technology, Engineering, Art and Mathematics) learning based on PjBL (Project Based Learning) (Fitriyah & Ramadani, 2021).

According to Desi et al. (2023), the benefits of PjBL (Project Based Learning) learning include improved resource management abilities, motivation, problem-solving abilities, and teamwork. PjBL has the potential to enhance student achievement, creativity, and critical thinking abilities. The STEM (Science, Technology, Engineering, Mathematics) approach is one method for resolving the learning issues mentioned above. Because engineering is a process of educating creativity, STEM is appropriate for creativity (Desi et al., 2023).

Research Method

This study employed a qualitative literature review design. Relevant journal articles were collected from Google Scholar using the keyword 'STEM-PjBL and creative thinking skills'. The inclusion criteria were: (1) studies published between 2017–2023, (2) articles discussing the implementation of STEM-PjBL in formal education, and (3) studies explicitly measuring or analyzing students' creative thinking skills. Fourteen studies met these criteria and were analyzed using a journal matrix table. The data analysis involved categorizing study findings, identifying similarities and differences, and synthesizing patterns across research results.

Result and Discussion

The literature review findings indicate that STEM-PjBL consistently improves students' creative thinking skills. Across the reviewed studies, students showed better idea generation, problem-solving ability, and engagement in higher-order thinking. STEM-PjBL integrates authentic projects with scientific and technological principles, providing opportunities for students to design, experiment, and present solutions. The inclusion of engineering design processes in STEM-PjBL also encourages systematic problem-solving. Table 1 presents the summary of reviewed studies..

Table 1. Literature Study Results

NO	Author/Year	Title	Main Findings
1.	(Kristiani et al., 2017)	The Effect of STEM-PjBL Learning on Creative Thinking Skills	STEM-PjBL improved students' creativity and engagement.
2.	(Sukmawijaya et al., 2019)	The Effect of the STEM-PjBL Learning Model on Students' Creative Thinking Skills on Environmental Pollution	Students showed better problem-solving and creative responses.
3.	(Karlina et al., 2023)	The Influence of the STEM-PJBL Learning Model on the Creative Thinking Skills of Students of SMP Negeri 1 Slogohimo Wonogiri in the Pandemic Era on the Hydrosphere Material	Enhanced creative thinking and conceptual understanding.
4.	(Desi et al., 2023)	The influence of the STEM-based PJBL model on creative thinking skills and biology learning outcomes of high school students.	Improved creativity and learning achievement.
5.	(Ningrum et al., 2021)	Implementation of STEM From Home with the PjBL Model to Improve Concept Mastery and Creative Thinking Skills of Middle School Students	Boosted mastery of concepts and creativity.

6. (Moammar Qadafi et al., 2022)	The Effect of the STEM-Integrated Project Based Learning (PjBL) Learning Model on Physics Subjects to Improve Creative Thinking Skills of Umar Kelayu High School Students in the 2021/2022 Academic Year	Students demonstrated higher creative problem-solving.
7. (Widana & Septiari, 2021)	Creative Thinking Skills and Students' Mathematics Learning Outcomes Using the Project-Based Learning Model Based on the STEM Approach	Improved creative thinking and learning outcomes.
8. (Fitriyani et al., 2022)	The influence of the PJBL-STEM learning model on high school students' creative thinking abilities on static fluid material	Significant increase in creative thinking skills.
9. (Alifa et al., 2018)	Application of the project-based STEM (Science, Technology, Engineering, Mathematics) method to improve the creativity of grade XI high school students on the topic of ideal gases.	Enhanced creativity through project-based tasks.
10. (Ward, 2017)	Improving students' mathematical creative thinking skills through a project-based learning model with a stem approach	Creative thinking skills improved after intervention.
11. (Harahap et al., 2022)	Improving Students' Mathematical Creativity through the STEM (Science, Technology, Engineering and Mathematics) Approach based on Project Based Learning (PjBL)	Better creativity through project-based STEM.
12.. (Marwani & Sani, 2020)	The Influence of the STEM-Based Project Based Learning Model on Students' Creative Thinking Skills on the Static Fluid Subject in Class XI of SMAN 4 Tebing Tinggi Academic Year 2019/2020	Improved creative thinking in science learning.
13. (Muttaqiin, 2023)	The STEM (Science, Technology, Engineering, Mathematics) Approach to Science Learning to Train 21st Century Skills	Strengthened 21st-century skills including creativity.
14. (Mahombar et al., 2023)	The impact of implementing the PJBL model with STEM on students' creative and critical thinking abilities	Enhanced both creative and critical thinking.

As shown in Table 1, all 14 reviewed studies reported positive effects of STEM-PjBL on creative thinking. This consistency across various subjects and educational levels indicates the robustness of the model in fostering creativity. The integration of STEM disciplines with PjBL provides contextual learning that motivates students, promotes collaboration, and encourages them to produce innovative solutions to real-world problems.

Conclusion

This literature review of 14 empirical studies demonstrates that the STEM-PjBL model consistently strengthens students' creative thinking skills across diverse subjects and educational levels. By integrating project-based learning with STEM principles, the model provides authentic, collaborative, and problem-oriented learning experiences that stimulate originality, innovation, and systematic problem-solving. These synthesized findings highlight STEM-PjBL as an effective pedagogical approach for equipping students with essential 21st-

century competencies, particularly creativity, in preparation for future academic and professional challenges.

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