

Project-Based Learning with Scratch to Improve Students' Creative Thinking Ability: Systematic Literature Review

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Abstract

Creative thinking abilities are crucial for students, particularly within the realm of mathematics, to tackle real-world challenges effectively. Regrettably, many students encounter difficulties in nurturing their creative thinking abilities due to the inadequate teaching methods and educational resources employed by instructors. As a result, there is a pressing demand for inventive teaching approaches and materials, with project-based learning using Scratch emerging as one such innovative method to foster students' creative thinking proficiencies. This research, which encompassed a systematic review, concludes that the utilization of the Project-based Learning approach with Scratch as an educational tool can indeed enhance students' creative thinking abilities in the context of mathematics education. Furthermore, it recommends further development by harnessing applications like Scratch or other visual programming tools and exploring alternative research models for comparative analysis.

Keywords: creative thinking abilities; mathematics learning; project-based learning; scratch

Abstrak

Kemampuan berpikir kreatif sangat penting bagi siswa, khususnya dalam bidang matematika, untuk mengatasi tantangan dunia nyata secara efektif. Sayangnya, banyak siswa mengalami kesulitan dalam mengembangkan kemampuan berpikir kreatifnya karena metode pengajaran dan sumber daya pendidikan yang digunakan oleh instruktur tidak memadai. Akibatnya, terdapat permintaan yang mendesak terhadap pendekatan dan materi pengajaran yang inventif, dengan pembelajaran berbasis proyek menggunakan Scratch yang muncul sebagai salah satu metode inovatif untuk mendorong kemampuan berpikir kreatif siswa. Penelitian yang bersifat tinjauan sistematik ini menyimpulkan bahwa pemanfaatan pendekatan Project-based Learning dengan Scratch sebagai alat pendidikan memang dapat meningkatkan kemampuan berpikir kreatif siswa dalam konteks pendidikan matematika. Selain itu, direkomendasikan pengembangan lebih lanjut dengan memanfaatkan aplikasi seperti Scratch atau alat pemrograman visual lainnya dan mengeksplorasi model penelitian alternatif untuk analisis komparatif.

Kata Kunci: kemampuan berpikir kreatif; pembelajaran matematika; project-based learning; scratch

1. INTRODUCTION

The process of programming encompasses diverse cognitive abilities and knowledge domains. It aids in fostering 21st-century competencies among children, such as communication, creativity, intellectual curiosity, critical and systematic thinking, interpersonal collaboration, problem definition, formulation, and resolution, as these skills are inherently ingrained in it. However, there is a notable scarcity of focus on enhancing creative thinking in the realm of mathematics.

It is imperative for students to cultivate creative thinking abilities when learning mathematics, as this facilitates a deeper comprehension of real-world problems (Suripah, 2017; Nurhikmayati & Sunendar, 2020). Unfortunately, many students still struggle to fluently apply existing knowledge or ideas and are unable to employ diverse methods or strategies when devising solutions. These issues often arise due to the failure of teachers to provide opportunities for students to express their unique ideas or problem-solving approaches, and the omission of the encouragement of creative thinking abilities to address issues. Leveraging technology and implementing Project-based Learning can serve as a viable solution. The utilization of visual programming media like Scratch can enhance educators' efforts to boost students' creative thinking abilities.

Project-based Learning with Scratch Media can empower students to cultivate creative thinking, logical reasoning, and collaborative abilities, all of which are vital in the 21st century. In the Scratch environment, students can craft their own narratives, games, simulations, and interactive animations, and they can readily share their creations with peers through a straightforward coding process (Resnick, Maloney, & Monroy, 2009; Rusk, Silverman, & Eastmond, 2010).

Consequently, through Project-based Learning and the structured use of Scratch, guided by teachers, students become more actively engaged, and their creative thinking capacities flourish. They develop a deeper understanding of problem-solving and gain the ability to devise a range of innovative solutions to challenges.

For educators, this research holds great importance as it serves as a roadmap for enhancing the utilization of Project-based Learning with Scratch, aimed at enhancing students' capacity for creative thinking and offering learning support within educational contexts, particularly in the field of mathematics, tailored to students' cognitive development levels. The objective of this methodical analysis is to amalgamate discoveries from prior research in order to offer a more holistic perspective on the implementation of Project-based Learning with Scratch, specifically in its role in augmenting students' creative thinking abilities and other relevant aspects that pertain to future advancements. This process encompasses multiple phases, with the initial step involving the compilation of literature based on predefined criteria. Subsequently, an evaluation of data, spanning both qualitative and quantitative data, is conducted. Ultimately, all pertinent insights drawn from prior research are synthesized, culminating in a comprehensive depiction of the current state of research and the substantial impact of the applied approach.

2. RESEARCH METHOD

This research uses the Systematic Literature Review (SLR) method which aims to identify, review, and evaluate all relevant research so that answers to research questions are determined (Triandini, Jayanatha, Indrawan, Werla Putra & Iswara, 2019). This research involves multiple phases, including the creation of research inquiries, conducting literature searches, establishing criteria for inclusion and exclusion, choosing relevant literature, presenting, and analyzing data, and ultimately formulating

conclusions. The goal of this systematic review is to analyze the influence of Project-based Learning with Scratch which is used to improve creative thinking abilities in mathematics learning.

Information was extracted from the Google Scholar databases within the timeframe of 2017 to 2023, employing the search terms 'creative thinking abilities,' 'project-based learning,' and 'scratch'. The literature search incorporated specific inclusion criteria, which encompassed studies focusing on the enhancement of students' creative thinking skills through project-based learning with Scratch, and it considered research findings published in journals or national seminar proceedings. The collected literature was then subjected to scrutiny and assessment based on these inclusion and exclusion criteria. After rigorous evaluation following the inclusion criteria, this set was narrowed down to a final selection of 8 articles.

3. RESULT AND DISCUSSION

Table 1. Research Output of the Final Articles

Researchers & Year	Journal	Research Output
(Nisa et al., 2023)	ProSANDIKA UNIKAL (Prosiding Seminar Nasional Pendidikan Matematika Universitas Pekalongan)	Scratch empowers students to leverage their creative talents in crafting games, animations, narratives, and simulations that pertain to the realm of mathematics education. Consequently, the incorporation of Scratch media in mathematics instruction yields positive outcomes and has the potential to captivate students' enthusiasm for mathematics more effectively than traditional, media-free teaching methods.
(Chen, Shih-Yeh, et al., 2022)	The International Journal of Electrical Engineering & Education	The findings indicate that the project-based learning method effectively enhances students' creative thinking, particularly in terms of fluency and adaptability. Additionally, during interviews, students expressed that they found suitable creative thinking approaches to be highly effective in fostering their creativity. As a result, it is crucial to furnish students with a range of creative thinking tools to encourage

		the development of creative thinking habits.
(Vionohovska, Valentina, and Evgenia Goranova, 2018)	ICERI2018 Proceedings	Scratch has the potential to serve as a valuable instrument for improving the educational process across various subjects. It showcases the capacity of its visual programming environment to act as a foundational tool that aids project-based learning in diverse academic areas, fostering creative thinking and collaborative skills among students.
(Afrilianto, M., Tina Rosyana, & Linda Linda, 2022)	AKSIOMA: Jurnal Program Studi Pendidikan Matematika	The utilization of the Scratch application proves to be highly beneficial for nurturing creative thinking skills in mathematics. Both students and teachers have expressed overwhelmingly positive feedback regarding the Scratch application. Therefore, the Scratch application can be a valuable aid in simplifying the learning process for students and is highly recommended for further development.
(Fitriyah & Ramadani, 2021)	Jurnal Inspiratif Pendidikan	Project-based STEAM learning, when employed, demonstrated a notable impact on the enhancement of students' creative thinking abilities. As a result, it can be inferred that project-based STEAM learning offers a viable educational alternative for nurturing 21st-century skills.
(Rahmazatullaili, Zubainur, & Munzir, 2017)	Jurnal Tadris Matematika	Students exhibit improved creative thinking skills following the implementation of the project-based learning model compared to their pre-implementation levels.
(Widana, & Septiari, 2021)	Jurnal Elemen	The project-based learning model with a STEM approach has an impact on the

		development of creative thinking skills.
(Husna, Cahyono, & Fianti, 2019)	Journal of Innovative Science Education	Based on an examination of students' reactions during the learning process, it was observed that students in the experimental class displayed highly favorable responses. These findings suggest that the utilization of PjBL in conjunction with Scratch media effectively cultivates students' creativity and leads to positive learning outcomes.

The research results of several articles in the table above show a good relationship between Project-based Learning and Scratch in improving students' creative thinking abilities. Nisa et al. (2023) stated that Scratch allows students to utilize their creative talents in creating a project related to the field of mathematics education. They also stated that the use of Scratch in mathematics learning is more effective than media-free learning. A similar statement was also put forward by Afrilianto et al. (2022) that the use of Scratch in mathematics learning is very useful for improving students' creative thinking abilities.

In research conducted by Chen, Shih-Yeh, et al. (2022) shows that the Project-based Learning method is effective in improving students' creative thinking abilities. This statement was also put forward by Rahmzatullaili, et al. (2017), that after implementing Project-based Learning, students' creative thinking abilities increased.

Scratch has the potential to become a valuable learning medium for improving students' creative thinking abilities in Project-based Learning (Vionohovska, et al., 2018). Project-based learning with a STEM/STEAM approach shows an impact on increasing students' creative thinking abilities (Fitriyah & Ramadani, 2021; Widana, & Septiari, 2021), where one of the STEM/STEAM media is Scratch.

The use of Project-based Learning together with Scratch media is effective in improving students' creative thinking abilities (Husna, et al., 2019). The research findings indicate that employing Project-based Learning with Scratch can enhance students' creative thinking skills, particularly within the context of mathematics education. In alignment with the research objective of evaluating the impact of Project-based Learning with Scratch on the enhancement of creative thinking skills in mathematics, the results underscore that integrating collaboration and programming into mathematical instruction can positively influence students' creative thinking abilities in the realm of mathematics.

4. CONCLUSION

The evident inference suggests that implementing Project-Based Learning with Scratch media has the potential to elevate students' creative thinking abilities within the realm of mathematics education. The utilization of Scratch, as an educational tool, not only fosters engagement but also encourages students to actively construct their understanding of mathematical concepts. This dynamic approach, coupling Project-Based Learning with a hands-on programming environment like Scratch, emerges as an effective strategy to stimulate creative thinking ability.

5. RECOMMENDATION

Based on the outcomes of this research, it is recommended to explore additional innovations utilizing Scratch or comparable visual programming applications. Furthermore, there is a suggestion to delve into alternative research models that facilitate comparative analyses. This would contribute to a more comprehensive understanding of the impact and effectiveness of visual programming environments like Scratch in educational settings, fostering continuous improvement and informed decision-making in the realm of educational technology.

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