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Instructional Strategies In Mathematics Learning For Developing Students' 4C Abilities: A Literature Review

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Abstract

In the 21st century, students are expected to master the 4C skills: creativity, critical thinking, communication, and collaboration, in order to remain competitive in a globalized world. However, the integration of these skills into mathematics learning, particularly within the context of Islamic education, remains suboptimal. This study aims to identify and analyze mathematics learning strategies that enhance students' 4C skills through a systematic literature review. The research employed the PRISMA method to guide the selection of relevant articles. A total of 47 articles published between 2016 and 2025 were initially identified from the Google Scholar database, and 15 met the inclusion criteria for final analysis. The review found that Project-Based Learning (PjBL), Problem-Based Learning (PBL), STEM approaches, and other innovative strategies significantly contribute to the development of students' 4C competencies. These strategies foster active engagement, encourage creative and critical problem-solving, and enhance both communication and collaboration in mathematics learning. The findings emphasize the importance of adopting more student-centered learning models that support the development of 4C skills. This study offers valuable insights for curriculum developers and educators in designing effective mathematics instruction that equips students to face global challenges.

Keyword: 4C Skills, Mathematics Learning, Learning Strategies.

INTRODUCTION

In the current era, it is essential for every individual to acquire a diverse set of skills to remain competitive in the global landscape (Juhji & Suardi, 2018). After completing their studies, individuals must be prepared and equipped with the skills to compete in real life. Those who lack

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the necessary skills are likely to be overwhelmed by the intensity of global competition (Mardhiyah et al., 2021). Therefore, in order to play a role in this era, individuals are required to possess several competencies or skills that can meet global demands. These competencies or skills include communication, collaboration, critical thinking, and creativity, collectively referred to as the 4C's (Ritonga et al, 2021).

Communication is closely related to an individual's ability to convey ideas, concepts, and thoughts quickly, clearly, accurately, and effectively (Haryanti & Suwarma, 2018). Additionally, communication skills are also associated with a person's ability to deliver messages to an audience (Dewi et al., 2020). This skill encompasses several aspects, including verbal, written, and visual communication, listening, understanding various cultures and disciplines, as well as the ability to engage in communication through multimedia (Indriyani, 2020). Another aspect closely related to communication skills is the ability to express thoughts clearly and persuasively, both orally and in writing. This includes the capacity to convey opinions in clear sentences, give precise instructions, and motivate others through speaking skills (Experenza et al., 2019). Communication skills are not innate and do not emerge suddenly, these skills must be learned and practiced (Elisa, 2019). Communication skills can be enhanced through interactive learning activities, such as problem-solving discussions, games, and role-playing, which provide opportunities for individuals to actively engage and practice these skills (Maridi et al., 2019; Mugara et al., 2019; Safitri et al., 2019; Sholihah et al., 2018).

Collaboration is essentially the activity of working together, synergizing with various parties, and taking responsibility for oneself, society, and the environment (A'yun, 2021). Collaboration skills require an individual to be able to cooperate with others within a group to achieve common goals (Safitri et al., 2019). These collaboration skills need to be developed in students. With these skills, students are able to work effectively with others, enhance empathy, foster a sense of responsibility, adapt to their environment, and accept others' perspectives (Indrawan et al., 2021).

Critical thinking is related to the ability to reason, express, analyze, and solve problems (Alsaleh, 2020). Critical thinking skills refer to an individual's ability to reason effectively, ask insightful questions, and solve problems critically, analyze and evaluate alternative perspectives, and reflect on processes and decisions (Zulkarnain, 2020). These skills also encompass other abilities, such as communication and information skills, as well as the capacity to examine, analyze, interpret, and evaluate evidence (Monteiro et al., 2020).

An individual with critical thinking skills is able to ask the right questions, gather relevant and effective information, logically assess the information, and draw reliable and convincing

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conclusions about the world, enabling them to live and succeed in it (Cáceres et al., 2020). They are also capable of solving problems, making decisions, persuading, analyzing assumptions, and conducting scientific research (Changwong et al., 2018). Critical thinking typically begins with the ability to critique various phenomena in one's surroundings and then evaluate them from a specific perspective. The individual then positions themselves to transform an unfavorable situation into one that works in their favor (Saleh, 2019). Critical thinking is an essential skill for life, work, and functioning effectively in all other aspects of life. In line with the development of science and technology, it is necessary for students to think critically in order to adapt to the changes that occur (Willingham, 2019).

Creativity is related to an individual's ability to produce something new (Widodo & Wardani, 2020). It also involves an individual's mental process that generates new ideas, methods, processes, or products that are imaginative, flexible, and effective, and are useful in various fields for solving problems (Adiesty Hereza, 2019). Individuals with high creativity can think critically and view problems from multiple perspectives, leading to open-minded solutions (Setyowati, 2021). Developing students' creativity is essential to generate breakthroughs or innovations in the field of education (Lubis, 2018). With creativity, students will gain a competitive edge and have opportunities to meet their life needs (Fatimah, 2020).

Unfortunately, the portrayal and implementation of Islamic education to develop students' 4C's skills have not been optimal. This is due to some teachers still not designing lessons effectively (Ramdiah et al., 2019). As a result, the levels of communication, collaboration, critical thinking, and creativity, collectively known as the 4C's, remain relatively low (Al Husna et al., 2021; Prafitasari et al., 2021; Suyamto et al., 2020). Yet, these skills are crucial for students to face global competition in the 21st century.

Although 4C skills are crucial for preparing students to face global challenges in the 21st century, research on mathematics learning strategies that enhance creativity, critical thinking, communication, and collaboration skills remains limited. This study contributes new insights by systematically reviewing various mathematics teaching approaches and strategies that can improve 4C skills, providing valuable guidance for educators in designing more effective lessons. Building on this gap, the purpose of this study is to identify and analyze mathematics learning strategies that can enhance students' creativity, critical thinking, communication, and collaboration (4C's) skills through a systematic literature review.

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METHOD

The research employed a systematic literature review method. This approach involves identifying, critically evaluating, gathering, and analyzing data from relevant studies to collect empirical evidence aimed at answering specific research questions or hypotheses (Snyder, 2019). In this study, the authors searched for articles on Strategies to Enhance Students' Creativity, Critical Thinking, Communication, and Collaboration (4C) in Google Scholar database, focusing on those published over the last 9 years, from 2016 to 2025. The process of searching for articles analyzed in this study is illustrated in the following Figure 1.

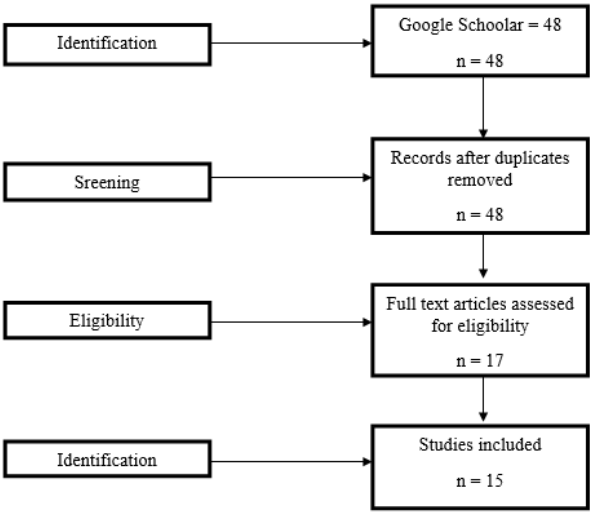


Figure 1. PRISMA flow diagram

The image presented is a flowchart illustrating the article selection process using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method, widely used in systematic literature review-based research. The flowchart outlines the steps from identification, screening, and eligibility assessment, to the final inclusion of studies for analysis.

a) In the Identification stage

A comprehensive literature search was performed across various databases. The diagram indicates that a total of 47 articles were sourced from four primary platforms, including Google Scholar. These articles were collected based on keywords pertinent to the research topic, with the goal of compiling as many potentially relevant studies as possible. This initial phase focuses on gathering a broad pool of articles, without an in-depth assessment of their relevance. As a result, an initial set of 47 articles was obtained.

b) Screening

Following the collection of articles from multiple sources, the subsequent step is to

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eliminate any duplicates. Duplication can happen when an article appears in more than one database or has been unintentionally downloaded multiple times during the search. However, in this case, after removing duplicates, the total remains at 47 articles, indicating that no duplicates were actually present in the initial collection. This screening step is essential as duplicate articles could skew the analysis and create redundant information. By confirming the uniqueness of each article, the process ensures a more accurate basis for further analysis.

c) Eligibility Assessment

Out of the 47 articles initially collected, only 15 met the criteria for further evaluation. During this phase, each article is reviewed against specific inclusion and exclusion criteria, which may encompass aspects like study type, methodology, publication year, and relevance to the research question. This eligibility review involves examining abstracts, conclusions, or even the full text if needed to assess whether an article is genuinely pertinent and appropriate for analysis in the systematic literature review. At this stage, any articles that prove irrelevant or fail to meet the criteria are excluded from the review.

d) Included Studies

Following the eligibility assessment, only 15 of the 17 evaluated articles were selected for the final analysis. These articles represent the studies that fully met all inclusion criteria established by the researchers. The selected studies will undergo a thorough analysis, conducted either qualitatively or quantitatively, depending on the chosen review methodology.

RESULTS AND DISCUSSION

Results should be clear and concise. The results should be supported by sufficient data. The following components should be covered in the discussion: How do your results relate to the original question or objectives outlined in the Introduction section (what/how)? Do you provide interpretation scientifically for each of your results or findings presented (why)? Are your results consistent with what other investigators have reported (what else)? Or are there any differences? Please highlight differences between your results or findings and the previous publications by other researchers.

In this systematic literature review (SLR) examining mathematics learning strategies aimed at enhancing students' 4C skills (Creativity, Critical Thinking, Communication, and Collaboration), several key findings emerged. Based on the eligibility criteria, the selected studies were analyzed to identify the various instructional strategies and their impact on the 4C

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competencies. Below is a summary of the results derived from the review of the identified articles:

1. Project-Based Learning (PjBL) and 4C Skills Development

Several studies highlighted the positive effects of Project-Based Learning (PjBL) on developing 4C skills. For instance, Amroni et al. (2024) explored the impact of a project-based learning model on elementary school students' 4C skills, demonstrating significant improvement in critical thinking, creativity, communication, and collaboration. Similarly, Firda & Sunarti (2022) and Kurniahtunnisa et al. (2023) found that PjBL facilitated the development of 4C competencies in mathematics, emphasizing the importance of real-world problem-solving contexts in enhancing students' collaborative and communication skills.

2. Technology Integration and Its Impact on 4C Skills

The incorporation of technology in mathematics learning was another common theme. Bertsch (2022) examined the effects of one-to-one technology implementation on high school students, finding that it significantly enhanced communication, collaboration, critical thinking, and creativity. This was supported by findings from Fitriati et al. (2023), which emphasized that technological tools fostered the development of these 4C skills by providing interactive learning environments.

3. Challenges in Teaching 4C Skills

Some studies focused on the challenges teachers face when trying to integrate 4C skills into their mathematics instruction. For example, Fitriati et al. (2023) identified that prospective mathematics teachers faced difficulties in preparing students for the 4C skills in classroom settings. Similarly, Burieva (2025) discussed global perspectives on fostering these skills, underscoring the necessity for both teacher training and contextual adaptation of strategies to overcome these challenges.

4. Curriculum and Pedagogical Innovations

A significant number of studies underscored the role of innovative curricula and pedagogical models in developing 4C competencies. Irham et al. (2022) proposed a 4C-focused teaching model that successfully improved students' mathematical critical thinking skills, while Yulianto et al. (2024) explored the impact of project-based learning on the development of 21st-century skills. Their findings indicated that integrating collaborative group activities within mathematics lessons enhanced students' problem-solving abilities and fostered creativity.

5. Assessment and Evaluation of 4C Skills

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Several studies emphasized the need for effective assessment tools to evaluate the development of 4C skills in mathematics. For instance, Zakaria et al. (2024) examined the validity of instruments used to assess teachers' perceptions of 4C skills in mathematics problem-solving. They found that well-designed assessments were crucial in monitoring the growth of these competencies. Moreover, Zakiah & Fajriadi (2020) discussed the management of authentic assessment in mathematics lessons, which was found to be effective in measuring and developing students' creativity and collaboration.

6. Impact of STEM-PjBL on 4C Skills

The integration of STEM-based project learning models was also explored in several studies. Kurniahtunnisa et al. (2023) focused on the STEM-PjBL approach, which significantly impacted students' critical thinking, creativity, communication, and collaboration skills, demonstrating that interdisciplinary approaches enhance the development of 4C competencies.

CONCLUSION

In conclusion, this systematic literature review highlights the importance of various mathematics learning strategies in enhancing students' 4C skills—creativity, critical thinking, communication, and collaboration. Approaches such as Project-Based Learning (PjBL), technology integration, and STEM-based models have proven effective in fostering these competencies. However, challenges remain in implementing these strategies, particularly in teacher preparation and contextual adaptation. This study provides valuable insights for educators to design more effective mathematics lessons that not only improve students' mathematical abilities but also equip them with essential 21st-century skills necessary for global competition.

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