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Strengthening Problem-Solving, Creativity, Collaboration, And Communication (4c) Skills In 21st Century Learning In Digital Era

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Abstract

Abstract:
The development of digital technology in the 21st century has brought significant changes in the field of education, particularly in the development of skills that are relevant to the demands of the era. One of the important skills that needs to be developed is 21st-century skills, known by the concept of the 4Cs, namely critical thinking or problem solving, creativity, collaboration, and communication. This study aims to examine the strengthening of the 4C skills in 21st-century learning in the digital era. The research uses a qualitative approach with a literature review method that analyzes various scientific articles from 2020–2025 obtained through databases such as Google Scholar, ERIC, ScienceDirect, and arXiv. The results of the study show that the 4C skills are the main competencies that must be developed in the learning process to prepare students to face global challenges and technological developments. Strengthening these skills can be carried out through the implementation of innovative learning models such as project-based learning, collaborative learning, as well as the utilization of digital technology that supports interactive, creative, and problem-solving-based learning activities. However, the implementation of 4C skills still faces several challenges, such as the dominance of conventional learning methods, limited teacher understanding of 21st-century learning strategies, and the lack of technological facilities in some educational institutions. Therefore, it is necessary to improve teacher competence, provide educational policy support, and optimize the use of digital technology so that learning can effectively develop 21st-century skills.

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INTRODUCTION

The massive development of digital technology in the 21st century has brought significant changes in various areas of life, including education. Digitalization drives

the transformation of learning methods, information access, as well as more innovative and interactive teaching methods. In this context, education no longer focuses solely on knowledge mastery, but also on the development of skills relevant to the demands of the global era and technological advancements (Romero, 2026). Currently, the education system emphasizes the importance of 21st-century skills known as the 4C concept, namely critical thinking or problem solving, creativity, collaboration, and communication. These four skills are considered core competencies that learners need to possess to face the complexities of modern-world problems as well as the rapid development of digital technology (Papagiannis & Pallaris, 2024).

The limited understanding of teachers regarding 21st-century skills-based learning strategies also becomes an obstacle in implementing effective learning. Many teachers are not yet fully able to integrate digital technology and innovative learning strategies to develop 4C skills in teaching and learning activities (Hidayat et al., 2024). Another problem is the limited facilities and technological infrastructure in some educational institutions in areas far from the city center. This situation causes the utilization of digital technology in learning to not run optimally, thus the opportunity to develop 21st-century skills in students also becomes limited (Wati et al., 2022).

Several previous studies have shown that the implementation of innovative learning strategies can improve students' 21st-century skills. Research by Papagiannis and Pallaris (2024) indicates that makerspace-based learning can enhance critical thinking, creativity, collaboration, and communication skills through exploratory and collaborative learning activities. Another study conducted by Wang and Shen (2025) shows that a supportive learning environment and the use of digital technology have a positive impact on the development of students' creativity. This indicates that the use of technology in learning can provide opportunities for students to develop various essential skills in 21st-century learning. Research by Romero (2026) emphasizes that the development of the 4C skills is greatly influenced by the learning design implemented by educators. Actively and collaboratively designed learning has been proven to enhance students' critical thinking, creativity, as well as communication skills. Most research still focuses on specific aspects of the 4C skills and has not examined the integration of all four skills comprehensively in digital-based learning (Yuliana & Irawan, 2024).

Research that examines strategies for strengthening problem-solving, creativity, collaboration, and communication skills in an integrated manner within the context of 21st-century learning in the digital era is still relatively limited. Therefore, research is needed that can provide a deeper understanding of how the 4C skills can be effectively integrated into the learning process.

METHODS

The approach in this study uses a qualitative method with a literature review. This method aims to examine in depth various concepts, theories, and research results related to strengthening problem-solving skills, creativity, collaboration, and communication (4C) in 21st-century learning in the digital era. A literature review is

chosen because it can provide a comprehensive overview of research developments as well as learning practices that support 21st-century skills (Hafizhah et al., 2024).

With this approach, it is possible to identify various models, strategies, and learning innovations that have been used in the development of 4C skills. In addition, the literature study method can also be used to examine various previous research findings so that it can provide a strong conceptual basis for understanding the implementation of 21st-century learning (Papagiannis & Pallaris, 2024). The data sources in this study consist of secondary data obtained from various scientific publications such as national and international journal articles, conference proceedings, as well as research reports relevant to the research topic. The literature used was obtained through scientific databases such as Google Scholar, ERIC, ScienceDirect, and arXiv. The criteria for the literature used in this study include:

1. Scientific articles published in the period 2020–2025.
2. Articles that discuss 21st-century skills, 4C skills, digital learning, and learning innovation.
3. Articles published in scientific journals or proceedings that have academic credibility.

The selection of these literatures was carried out to ensure that the sources used were relevant to the research topic and reflected the latest developments in 21st-century education studies (Akmal et al., 2023). Data collection was carried out through systematic literature searching using several keywords such as 21st century skills, 4C skills, critical thinking, creativity, collaboration, communication, and digital learning. The literature search was conducted through scientific databases to obtain articles relevant to the research topic.

Through scientific databases to obtain articles relevant to the research topic. Next, the obtained articles are selected based on the suitability of the title, abstract, and content of the articles with the research focus. The selection process is carried out to ensure that the articles used are truly related to the strengthening of 4C skills in 21st-century learning (Supandi et al., 2025). Articles that have met the criteria are then classified based on research themes, such as the concept of 21st-century skills, the implementation of 4C skills in learning, and the role of digital technology in supporting the development of these skills (Lestari & Hindun, 2023).

RESULT AND DISCUSSION

The results of the literature review indicate that 4C skills (critical thinking/problem solving, creativity, collaboration, and communication) are key competencies that must be developed in 21st-century learning. These skills serve as an essential foundation for preparing students to face increasingly complex social, economic, and technological changes in the 21st century. In the context of modern education, mastery of the 4C skills not only contributes to improving academic abilities but also supports the development of adaptability, innovation, and real-life problem-solving abilities (Hafizhah et al., 2024).

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Strengthening problem-solving skills is one of the primary focuses in 21st-century learning. Based on constructivist theory, students gain deeper understanding when they are actively involved in the process of finding solutions to problems they encounter. Research shows that problem-solving-oriented learning can enhance students' critical and analytical thinking abilities in understanding learning concepts more comprehensively (Partono et al., 2021).

In addition to problem-solving ability, creativity is also an important component of the 4C skills. Creativity enables students to generate new ideas, discover innovative solutions, and develop flexible ways of thinking when facing various learning challenges. Studies indicate that the use of digital learning media and innovative approaches, such as the development of digital media or creative projects, can enhance students' creativity in the learning process (Amral & Sumiharti, 2024). In 21st-century learning, collaboration is also a crucial skill because students are expected to work effectively with others to solve complex tasks or problems. Social learning theory emphasizes that interaction and cooperation within groups can improve students' understanding of learning materials. Research findings show that group discussions, project-based learning, and other collaborative activities can enhance students' teamwork and sense of responsibility in the learning process (Supandi et al., 2025).

Communication skills are also an essential aspect of 21st-century learning. Effective communication enables students to convey ideas, opinions, and solutions clearly to others. In the learning process, communication skills can be developed through discussions, presentations, and collaborative learning activities. Studies show that learning environments emphasizing active communication can improve students' ability to express opinions and construct logical arguments (Sukirwan et al., 2024).

Other literature review findings also indicate that the integration of digital technology in learning plays an important role in supporting the development of 4C skills. Digital technology can be used as a medium for accessing information, collaborating online, and developing various creative learning activities. Research shows that the use of digital technology in learning can significantly improve students' critical thinking, creativity, communication, and collaboration skills (Hafizhah et al., 2024). Furthermore, innovative learning models such as project-based learning and makerspace learning have also proven effective in enhancing 4C skills. Project-based learning provides students with opportunities to work collaboratively in completing real-world projects, thereby simultaneously developing their problem-solving, creativity, and communication abilities (Papagiannis & Pallaris, 2024).

However, several studies indicate that the implementation of 4C skills in learning still faces various challenges. One of the main challenges is the limited understanding among teachers regarding effective instructional strategies for developing these skills. In addition, some schools have not fully integrated 4C skills into the planning and implementation of learning activities. Although 4C skills have begun to be integrated into

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the curriculum, their classroom implementation still requires support from various stakeholders, including teachers, schools, and educational policies that promote innovative learning. A supportive learning environment and the optimal use of digital technology can help enhance the effectiveness of 21st-century learning.

Based on the results of this review, it can be concluded that strengthening problem-solving, creativity, collaboration, and communication skills is an essential part of 21st-century learning in the digital era. The implementation of these skills can be achieved through the application of innovative learning models, the utilization of digital technology, and the improvement of teachers' competencies in designing learning activities oriented toward developing 21st-century skills. Thus, education can produce students who possess competencies relevant to the demands of modern societal development. The following infographic illustrates the research findings derived from the literature review.

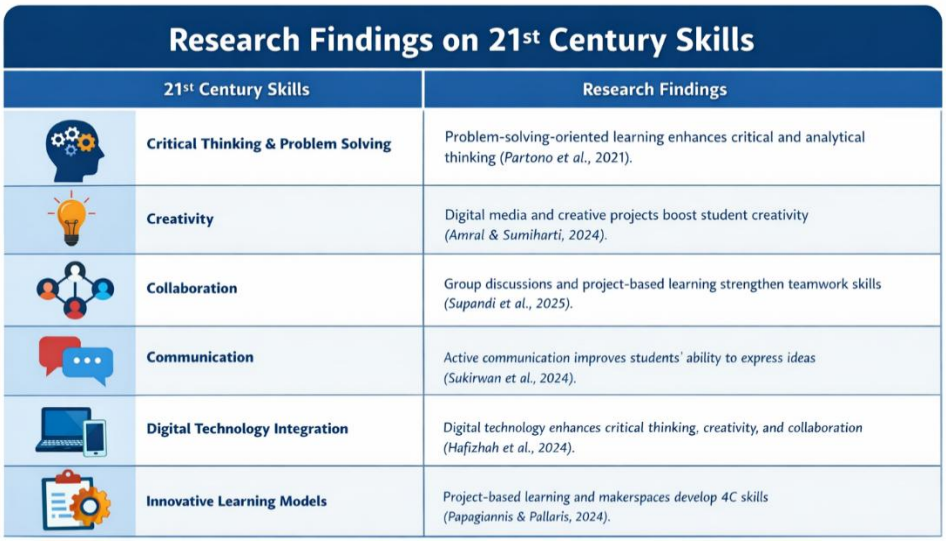

Figure 1. Summary of Literature Review Findings on 21st-Century Skills.

CONCLUSION

The findings of this study indicate that 21st-century skills, commonly referred to as the 4C skills critical thinking and problem solving, creativity, collaboration, and communication are essential competencies that need to be developed within the learning process in the digital era. These skills play a significant role in preparing students to address increasingly complex social, economic, and technological challenges.

The development of 4C skills can be effectively supported through the implementation of innovative learning models, such as project-based learning, collaborative learning, and the integration of digital technology that facilitates interactive, creative, and problem-solving–oriented learning experiences. The integration of digital technology provides opportunities for students to access diverse

sources of information, collaborate in online environments, and develop innovative ideas and solutions.

However, the implementation of 4C skills in educational practices still faces several challenges. These include the continued reliance on conventional teaching methods, limited teacher understanding of effective 21st-century learning strategies, and insufficient technological infrastructure in some educational institutions. Therefore, continuous efforts are required to enhance teachers' professional competencies, strengthen supportive educational policies, and provide adequate technological facilities.

In conclusion, the systematic integration of problem-solving, creativity, collaboration, and communication skills into the learning process is crucial to ensure that education can produce learners who possess competencies relevant to the demands of the digital era and the rapidly evolving global society.

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