

Theachers' Roles and Pedagogical Strategies in the Integration of 21st Century Skills in Educational Institutions

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ABSTRACT

Global transformation and rapid technological advancement have compelled the world of education to adapt to the demands of 21st-century skills. In this context, teachers play a crucial role as learning facilitators who must be able to implement strategies that are relevant to both current and future needs. The objective of this study is to systematically examine the role of teachers and instructional strategies in supporting the implementation of 21st-century skills in educational institutions. This research adopts a systematic literature review method by analyzing several scholarly articles to obtain structured data on teaching strategies for applying 21st-century skills. The findings indicate that teachers have a central role in designing and implementing learning processes that foster critical thinking, communication, collaboration, and creativity (the 4C). Effective instructional strategies in this context include project-based learning, problem-based learning, and the integration of digital technology into teaching and learning activities. Teachers who successfully adopt these innovative strategies have been shown to enhance student engagement and promote collaborative and reflective learning environments. However, many teachers still face challenges related to training, understanding the concept of 21st-century skills, and limited supporting facilities in educational institutions. Therefore, it is essential for educational institutions and governments to provide ongoing professional development programs for teachers, along with adequate infrastructure and resources. These efforts are necessary to ensure the optimal and equitable implementation of 21st-century skills across all levels of education.

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1. INTRODUCTION

In the era of the Industrial Revolution 4.0 and Society 5.0, the field of education faces ever-evolving challenges driven by rapid technological advancements and social dynamics. This condition demands adjustments within the education system, particularly in preparing students to possess 21st-century skills such as critical thinking, creativity, effective communication, and the ability to collaborate in teams. These skills are essential for navigating the complexities of the workforce and an increasingly competitive global landscape. In response to these changes, the role of teachers is no longer limited to delivering content in the classroom. Teachers are now

expected to take on broader responsibilities as learning facilitators, motivators, learning process managers, assessors of student development, and innovators capable of creating dynamic and relevant learning environments in line with current developments. This transformation positions teachers as key agents in preparing a generation that is adaptive, creative, and ready to face the challenges of the future. (Astutik & Hariyati, 2021). Today's teachers are expected to possess adequate digital literacy and be capable of designing creative learning experiences that are relevant to the needs of the times. One way to achieve this is by implementing various innovative learning strategies, such as project-based learning, problem-based learning, and the scientific approach. These approaches aim to connect subject matter with real-life contexts, enabling students not only to understand theoretical concepts but also to apply them in concrete situations they encounter. Various literature reviews in Indonesia from 2021 to 2025 indicate that the successful development of 21st-century skills largely depends on strong collaboration between the teacher's role and the use of appropriate learning strategies.

According to (Astutik & Hariyati, 2021), teachers are not only responsible for facilitating learning but also must be capable of effectively integrating technology into the learning process to instill the 4C competencies Critical Thinking, Creativity, Communication, and Collaboration in students. Meanwhile, (Mardiana et al., 2024) highlight the importance of digital literacy and the creation of an inclusive learning environment as supporting factors that enable teachers to be more responsive to the diverse learning styles of students. On the other hand, (Lestari & Kurnia, 2023) add that enhancing teacher professionalism through the implementation of various innovative learning models plays a significant role in strengthening pedagogical skills and technological proficiency. However, they also note that this process still faces challenges, particularly regarding limited resources and teachers' readiness to adapt.

Based on this background, the present study aims to explore in depth the role of teachers in carrying out various strategic functions within educational settings. The primary focus is on how teachers implement innovative learning strategies to support the development of 21st-century skills in students. In addition, this research seeks to identify various challenges and opportunities in the process of teacher professional development, in order to formulate relevant and applicable recommendations to improve the quality of 21st-century education in Indonesia.

1.1 Definition of Entrepreneurship: An Islamic Insight. Pembahasan

A teacher is a professional figure who not only transmits knowledge but also serves as a source of learning, facilitator, learning process manager, mentor, motivator, evaluator, and innovator. In carrying out these roles, a teacher creates a learning environment that is adaptive, participatory, inclusive, and collaborative capable of accommodating the diverse learning needs of students and relevant to the challenges of the 21st century (Siti Syarah S. Tintis et al., 2024). Teachers play a highly crucial role in designing, implementing, and evaluating the entire learning process that focuses on the development of 21st-century skills. In the context of modern education, the role of teachers has undergone a significant shift from merely delivering information to becoming active facilitators responsible for creating a collaborative, reflective, interactive, and participatory learning environment (AL-Ulum & Wahab, 2025). Teachers are not only required to master the subject matter but also to design learning experiences that encourage students to develop critical thinking skills, communicate effectively, work in teams, and foster creativity and innovation. Thus, teachers become key agents in shaping students' character and competencies to ensure they are well-prepared to face the challenges of global life and the dynamics of the future workforce.

Project-Based Learning (PjBL) is an instructional approach that positions students as active participants in the learning process through their involvement in designing, managing, and completing real-world projects that stem from essential questions or complex challenges. In this approach, students work collaboratively in groups, exchanging ideas and taking on specific roles and responsibilities to achieve common goals (Prasetya et al., 2023). Throughout the process, students are trained to think critically when analyzing problems, propose creative solutions, communicate effectively, and build productive teamwork. Thus, PjBL not only helps students understand subject matter in a more contextual and meaningful way, but also fosters essential 21st-century skills such as creativity, collaboration, communication, and problem-solving both independently and in group settings (Zaeriyah, 2023).

Problem-Based Learning (PBL) is an instructional approach that emphasizes presenting real-world problems that are complex and do not have a predetermined solution. Through this approach, students are encouraged to engage actively in higher-order thinking processes, starting from analyzing the problem, formulating key questions, exploring various possible solutions, and designing steps to solve the problem collaboratively through group discussions and research activities. Throughout the learning process, students are not only trained to think critically and creatively but are also equipped with communication skills essential for effective teamwork. Although empirical studies on the implementation of PBL in Indonesian educational settings are still relatively limited, this approach has been widely acknowledged by education experts, particularly within the framework of constructivist theory. In various academic discussions and educational innovation webinars,

PBL is recognized as an effective strategy to foster students' contextual and meaningful problem-solving skills in response to real-world challenges.

Digital technology integration is a systematic process of incorporating devices, applications, and digital platforms into the learning process to enhance the effectiveness, efficiency, and quality of the learning experience. In the context of 21st-century education, this integration involves the use of various technological tools such as learning management systems (LMS), interactive multimedia, educational applications, and even social media, all aimed at supporting the development of critical thinking, creativity, communication, and collaboration skills (4C). Teachers play a vital role as designers and facilitators in creating learning environments that are active, participatory, and responsive to technological advancements. Therefore, digital technology integration is not merely about using tools, but also involves well-planned pedagogical strategies that are oriented toward meaningful and real-world-relevant learning (Zahrika & Andaryani, 2023).

Teachers today are increasingly active in utilizing various digital platforms such as WhatsApp, Google Classroom, Quizizz, and Zoom as part of technology-based learning strategies, particularly within blended and hybrid learning models. The use of these platforms not only facilitates interaction between teachers and students both online and offline, but also creates space for a more flexible, independent, and interactive learning process. Through WhatsApp, teachers can easily deliver information, provide direct feedback, and maintain two-way communication with students and parents. Google Classroom is used to manage learning materials, assignments, and assessments in a structured and systematic way. Meanwhile, Quizizz supports enjoyable, gamified learning that helps boost student motivation. Zoom enables virtual face-to-face meetings that allow for real-time discussions and collaboration. Overall, the implementation of this technology has proven effective in enriching students' learning experiences while simultaneously enhancing teachers' digital literacy. Furthermore, the use of these digital platforms trains students to develop effective communication skills, think critically when responding to questions or participating in discussions, and build teamwork in virtual group settings. Therefore, the integration of digital technology in education is not merely a technical solution, but a strategic step toward transforming education to support the development of 21st-century skills (Oktaviana & Dewi, 2022).

1.2 Challenges in Implementing 21st-Century Skills in Educational Practice

Teachers in the modern educational era face numerous obstacles in their efforts to effectively integrate 21st-century skills into classroom learning processes. One of the most significant challenges commonly encountered is the limited access to continuous professional development programs, which are intended to deepen teachers' understanding of core 21st-century skills particularly the 4Cs (Critical Thinking, Communication, Collaboration, and Creativity) as well as how to apply them concretely in teaching and learning activities. A study by Cut Kumala Sari et al. (2025) highlights that many teachers still struggle to access comprehensive training and relevant seminars that are essential for strengthening their pedagogical competence and professional skills in order to meet the demands of 21st-century education effectively (Sari et al., 2025). Moreover, a considerable number of teachers still lack a comprehensive understanding of the urgency and fundamental principles of innovative learning as a relevant and adaptive approach to addressing the evolving demands and challenges of modern education. This lack of awareness often results in limited initiative to design creative, contextual, and skill-oriented learning strategies aligned with 21st-century competencies. According to Wagiman Manik et al. (2024), there exists a noticeable gap between educational policies aimed at promoting 21st-century learning transformation and the actual implementation at the school level. This gap is primarily attributed to the low level of digital literacy among teachers and insufficient grasp of competency-based learning paradigms, which require effective collaboration, communication, creativity, and critical thinking. These factors collectively pose significant barriers to realizing learning practices that are responsive to the needs of the 21st century (Manik et al., 2024).

Issues related to the availability of educational facilities, infrastructure, and resources remain a major challenge in the implementation of 21st-century skills-based learning. This challenge is particularly evident in 3T regions (frontier, outermost, and disadvantaged areas), which continue to face significant disparities in access to adequate educational infrastructure. These obstacles are not limited to uneven and unstable internet connectivity but also include the lack of supporting devices such as computers, projectors, and proper classrooms that are conducive to active and interactive learning. As a result, the implementation of contextual and collaborative learning which is intended to promote active student participation and the integration of technology into teaching becomes difficult to carry out optimally.

A study conducted by Hartawati and Karim (2024) affirms that these infrastructural limitations have a direct impact on the quality of the learning process. Teachers and students are often unable to fully utilize digital media and learning platforms, ultimately hindering the adaptation to 21st-century learning models. The disparity in facility distribution between urban schools and those in 3T areas further widens the education quality gap, potentially obstructing equal achievement of essential competencies such as critical thinking, teamwork, and creativity in problem-solving. Therefore, greater attention from the government and education stakeholders is

urgently needed to ensure the fair and equitable provision of educational infrastructure, in order to support the realization of inclusive and sustainable learning transformation across all regions of the country (Azizah, 2024).

The study conducted by Nuraeni et al. (2024) also revealed a similar condition, highlighting a significant disparity in educational infrastructure between urban areas and remote regions. This gap is not only evident in terms of physical aspects such as the availability of stable internet connections, digital learning devices, and adequate classroom facilities but also in the unequal access to various learning resources that support the digital transformation of education. As a result of these limitations, teachers and students in remote areas struggle to fully utilize digital media as an integral part of the learning process. This condition directly affects their opportunities to actively participate in technology-based learning that is oriented toward 21st-century skills. The imbalance in access and facilities further widens the educational quality gap between regions, posing a major challenge in the effort to build an equitable, inclusive, and adaptive learning system that keeps pace with technological advancements and modern educational demands. Therefore, ensuring equitable distribution of educational infrastructure has become a strategic necessity that cannot be overlooked in the pursuit of justice and equality in education (Nuraeni et al., 2024).

1.3 Discussion

A. Interpretasi temuan

The findings of this study reaffirm that teachers hold a pivotal role in cultivating 21st-century skills among students, particularly through the effective application of innovative instructional models such as Project-Based Learning (PjBL), Problem-Based Learning (PBL), and the strategic integration of digital technologies within classroom settings. In the landscape of modern education, the role of teachers has shifted significantly from being mere transmitters of knowledge to becoming dynamic facilitators, motivators, innovators, and assessors who guide and support student-centered learning processes. By implementing PjBL and PBL, teachers create meaningful learning experiences that encourage students to engage actively in constructing knowledge, solve authentic problems, and collaborate with peers in a way that mirrors real-life contexts. These pedagogical approaches provide a fertile ground for the development of the core 21st-century competencies known as the 4Cs: Critical Thinking, Communication, Collaboration, and Creativity. Through such methodologies, students are not only equipped with academic content but also empowered with essential life skills that prepare them for success in an increasingly complex, interconnected, and technology-driven world.

This study reveals that while various innovative learning strategies have been introduced and some educators have begun to adopt them, their implementation still encounters significant challenges. These obstacles range from limited opportunities for professional development to a lack of comprehensive understanding of 21st-century learning principles among teachers. Furthermore, inadequate infrastructure especially in underdeveloped and remote areas continues to hinder the effective integration of these approaches. In many cases, teachers struggle to access the necessary technological tools, internet connectivity, and ongoing pedagogical support needed to fully embrace modern instructional methods. The study also highlights that successful implementation of 21st-century learning tends to occur in environments where teachers receive consistent training, mentorship, and access to high-quality digital resources. These supports not only enhance teacher competence but also build confidence in designing and delivering learning experiences that are interactive, student-centered, and aligned with the demands of contemporary education.

The study conducted by (Handiyani & Abidin, 2023) revealed that teachers with strong digital literacy skills and the ability to create an inclusive learning environment tend to be more successful in encouraging active student engagement. These findings highlight the importance of strengthening teachers' competencies in both digital and pedagogical domains as a response to the demands of modern education.

B. Hubungan Temuan dengan Literatur dan Teori

1. Project-Based Learning (PjBL) and Problem-Based Learning (PBL) are closely tied to the foundations of constructivist theory, as introduced by educational theorists Jean Piaget and Lev Vygotsky. This perspective views learning as an active, student-driven process where understanding is built through meaningful experiences and social collaboration, rather than through passive information delivery. In this approach, students are encouraged to take an active role in their learning by engaging in inquiry, teamwork, and reflective thinking. PjBL and PBL reflect these ideas by placing students in real-life situations that require them to explore problems, pose questions, and generate solutions either on their own or with peers. These methods not only help learners grasp subject matter more deeply but also nurture key 21st-century competencies like critical thinking, creativity, communication, and collaborative problem-solving.

A growing body of research supports the effectiveness of constructivist teaching methods in enhancing student outcomes. (SALSABILA & MUQOWIM, 2024) for example, observed that applying constructivist-based learning especially through project-based activities can significantly boost student motivation and engagement. This is largely because such methods promote hands-on involvement and the

use of higher-order thinking skills. When combined with digital tools and collaborative technologies, both PjBL and PBL create engaging, inclusive learning environments where students are empowered to take control of their own educational experiences. These insights reinforce the importance of constructivist practices, not only for academic success but also for helping learners develop the mindset and skills needed to face real-world challenges with confidence and innovation.

2. The integration of technology in learning activities is closely related to the TPACK (Technological Pedagogical and Content Knowledge) framework, which outlines the essential knowledge teachers must possess in technology, pedagogy, and content, as well as how these three elements can work together in a synergistic way. Within this framework, TPACK is divided into seven key components: technological knowledge, pedagogical knowledge, content knowledge, technological content knowledge, pedagogical content knowledge, and technological pedagogical content knowledge. This theory emphasizes that effective learning can only be designed when all three aspects are fully understood and integrated. A study by (Hasjiandito et al., 2023) found that teachers with strong TPACK competencies tend to be more successful in implementing hybrid learning that aligns with students' needs and current educational contexts.
3. According to Fullan, teachers play a central role as agents of change in the process of educational transformation. Without the active involvement of educators in creating and implementing innovations, transformation efforts risk becoming mere formalities without real impact. This perspective is reinforced by (Fadhuzzakiyy et al., 2025), which emphasize that educational innovation is not merely about adopting new technologies but requires comprehensive changes, including in teaching approaches, curriculum structure, and evaluation systems. Fullan and Donnelly also highlight that impactful transformation must be systemic and collaborative, encompassing cultural aspects, institutional structures, and integrated pedagogical practices.
4. According to (Yudianto et al., n.d.), continuous professional development for teachers plays a crucial role in improving the quality of learning in today's digital era. Teachers who regularly participate in training programs tend to be more prepared to implement 21st-century teaching approaches that emphasize creativity, innovation, and the effective use of technology. Beyond enhancing technical skills, such training also fosters a proactive and open-minded attitude toward change qualities that are essential in designing adaptive and collaborative learning experiences.

C. Implikasi

1. From practical implications, The findings of this study highlight the importance for teachers to continuously develop their pedagogical and digital competencies in order to effectively address the challenges of 21st-century education. The integration of technology in the learning process is no longer optional it has become a fundamental necessity for designing learning experiences that are both meaningful and relevant. Teachers need to familiarize themselves with various digital tools such as Google Classroom for managing online classes, Zoom for facilitating virtual face-to-face interactions, and Quizizz, which brings an element of fun through gamification-based learning. Implementing these technologies not only enhances the effectiveness of instruction but also encourages active student participation, fosters a collaborative learning environment, and cultivates critical and creative thinking skills. Therefore, mastering the use of educational technology is essential for teachers to create dynamic and future-ready learning environments.

For school principals, these findings can serve as a foundation for organizing ongoing internal training and encouraging the development of teacher learning communities. By fostering a school environment that allows teachers to explore and implement various innovative teaching approaches, a more dynamic and collaborative culture of learning can naturally emerge within the school.

2. From theoretical implications, The findings of this study further reinforce the relevance of several theoretical approaches that support 21st-century learning, such as constructivism, the Technological Pedagogical Content Knowledge (TPACK) framework, and the concept of educational transformation. These three approaches emphasize the importance of active student engagement in the learning process and the teacher's ability to integrate pedagogical knowledge, subject content, and technology in a cohesive manner. In cultivating 21st-century skills particularly critical thinking, creativity, communication, and collaboration (the 4Cs) instructional strategies must move away from teacher-centered models. Instead, learning should be participatory and connected to real-world contexts. Therefore, it is essential for teachers to take initiative and embrace innovation in order to create learning environments that are interactive, meaningful, and aligned with the needs of the times. The role of teachers as innovators serves as a vital foundation for achieving sustainable educational transformation.
3. From a policy perspective, the findings of this study highlight the critical importance of providing sustainable, well-planned, and widely accessible teacher training programs, particularly for educators

working in 3T regions (underdeveloped, frontier, and outermost areas). These training initiatives should not only aim to enhance pedagogical skills and technological proficiency but also strengthen teachers' capacity to design learning experiences that are relevant to the demands of the 21st century. In this regard, strong governmental support is essential through increased budget allocation for improving educational infrastructure such as reliable internet connectivity, access to digital devices, and digital platforms that support collaboration and innovative teaching practices. Additionally, a robust support system is needed, including teacher learning centers, professional learning communities, and ongoing mentoring programs to assist educators in implementing more adaptive and context-based instructional strategies. Policies that promote equitable access, continuous competence development, and sustained support for teachers will be key to achieving a more inclusive and enduring educational transformation across all regions of Indonesia.

D. Tantangan

This study also highlights a number of critical challenges faced by teachers in implementing 21st-century skills-based learning. reveal that many teachers still lack access to adequate professional training, particularly in the use of educational technology and the application of innovative teaching strategies. These limitations contribute to a weak understanding of the core principles of 21st-century education, which emphasize the development of four key competencies: critical thinking, creativity, communication, and collaboration. Without strong conceptual understanding and practical skills to integrate these approaches into classroom practice, teachers often revert to traditional teaching methods that are less responsive to the needs of today's learners. Furthermore, the lack of awareness about the importance of innovation in the learning process becomes another barrier to adopting contextual strategies that align with contemporary educational demands. Therefore, achieving meaningful educational transformation requires systemic efforts such as providing continuous professional development, consistent instructional mentoring, and strengthening teachers' awareness of the urgency of innovation in all aspects of teaching and learning.

The findings of that many teachers are still not fully prepared to adopt 21st-century learning, a situation further exacerbated by weak structural support within the current education system. This lack of preparedness is one of the key factors contributing to the gap between ideal educational policies and their actual implementation in the field. The challenges are even more pronounced in 3T areas (frontier, outermost, and underdeveloped regions), where limited access to the internet, a lack of digital devices, and inadequate classroom conditions serve as major barriers to the implementation of technology-based and innovative learning. As highlighted by Akaat Hasjiandito and colleagues (2023), TPACK training programs that have successfully enhanced teacher competence in urban areas have yet to reach educators in more remote locations equitably. This underscores the fact that the successful integration of 21st-century learning is not solely dependent on individual teacher capacity but also on the availability of a supportive ecosystem—such as continuous professional development, reliable digital infrastructure, and educational policies that are adaptive and inclusive of local contexts.

This study also reveals a number of fundamental challenges that teachers continue to face in implementing 21st-century skills-based learning. noted that many schools in remote areas still struggle with limited access to stable internet connections and adequate technological devices, which further widens the quality gap between urban and rural education. This condition not only hinders the use of digital media in the learning process but also weakens teachers' motivation to explore innovative, technology-driven teaching approaches. Moreover, the low level of digital literacy among both teachers and students serves as a barrier to optimizing the use of digital tools in the classroom. Many teachers remain unfamiliar with online learning platforms or interactive instructional methods that align with the development of essential 21st-century skills, such as critical thinking, creativity, collaboration, and effective communication. The lack of continuous professional training and limited understanding of how to integrate technology into teaching practices causes the adoption of modern learning strategies to progress slowly, especially in areas with limited access. Addressing these issues requires systemic efforts, including the provision of structured and ongoing professional development, equitable improvement of digital infrastructure, and education policies that are responsive to local contexts. Collaboration between central and regional governments is essential, particularly through affirmative programs that support teachers in 3T (frontier, outermost, and underdeveloped) regions, enabling them to design learning experiences that are globally relevant yet locally contextualized. Without comprehensive support for teachers as key agents of change, meaningful and equitable educational transformation will be difficult to achieve.

1.4 Conclusion

This journal emphasizes the critical role of teachers and innovative learning strategies in supporting the development of 21st-century skills, particularly the 4Cs: Critical Thinking, Communication, Collaboration, and Creativity. In facing the challenges of the Industrial Revolution 4.0 and the Society 5.0 era, teachers are no longer merely transmitters of information but are expected to serve as facilitators, innovators, and managers of contextual and future-oriented learning processes. This study employs a systematic literature review approach, analyzing a

range of scholarly articles published between 2021 and 2025. The findings reveal that project-based learning (PjBL), problem-based learning (PBL), and the integration of digital technology are among the most effective methods for cultivating 21st-century skills. These approaches align with constructivist theory and the TPACK framework, which emphasize the importance of integrating content knowledge, pedagogy, and technology. However, the implementation of these strategies still faces significant challenges. Teachers often lack access to continuous professional development, in-depth understanding of 21st-century skills, and adequate educational infrastructure particularly in 3T areas (underdeveloped, frontier, and outermost regions). Disparities in access to internet connectivity, digital devices, and training opportunities result in uneven adoption of technology-based learning across different regions of Indonesia.

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