

Integration of Innovative Learning Methods in 21st Century Skills Development: A Systematic Review

Riska Fitriyani¹, Nurlela², Nur Aqil³, Marba'i⁴, Rizqi Amelliyah⁵, Deby Rahma Khairani⁶,
Acep Musliman⁷, Dede Syukrillah Rifai⁸

^{1,2,3,4,5,6,7,8}Universitas Indraprasta PGRI Jakarta, Indonesia
riskafitriyani26@gmail.com

<i>Submit</i>	<i>Review</i>	<i>Publish</i>
11 Februari 2026	14 Februari 2026	28 Februari 2026

ABSTRACT

The rapid advancement of technology and the evolving demands of the global workforce have underscored the importance of integrating 21st-century skills into education. Science, Mathematics, and Technology Education (MIPA) play a pivotal role in developing the technical, cognitive, and interpersonal skills essential for students to thrive in a knowledge-driven economy. This systematic review aims to explore the integration of innovative learning methods to foster 21st-century critical competencies, including digital literacy, critical thinking, collaboration, communication, and creativity, within MIPA education. A comprehensive analysis of peer-reviewed studies published between 2018 and 2025 was conducted to identify key pedagogical approaches that effectively enhance these skills. Methods such as Project-Based Learning (PjBL), Inquiry-Based Learning (IBL), and Technology-Enhanced Learning (TEL) were identified as prominent strategies for promoting student engagement and developing transversal skills alongside domain-specific knowledge. Despite the promising outcomes, the review also highlights challenges related to curriculum integration, teacher preparedness, and resource allocation. It is concluded that a holistic approach, involving curriculum reforms, continuous professional development for educators, and cross-disciplinary collaboration, is essential to embed 21st-century skills within MIPA education successfully. This review provides valuable insights into how contemporary learning methods shape future-ready students equipped with the competencies needed to navigate an increasingly complex, technology-driven world.

Keywords: *Innovative Learning Methods, Project-Based Learning, STEM Education, Teacher Professional Development, 21st Century Skills*

ABSTRAK

Pesatnya kemajuan teknologi dan tuntutan angkatan kerja global yang terus berkembang telah menegaskan pentingnya pengintegrasian keterampilan abad ke-21 ke dalam pendidikan. Pendidikan Matematika, Ilmu Pengetahuan Alam, dan Teknologi (MIPA) memainkan peran penting dalam mengembangkan keterampilan teknis, kognitif, dan interpersonal yang esensial bagi siswa untuk berkembang dalam ekonomi berbasis pengetahuan. Tinjauan sistematis ini bertujuan untuk mengeksplorasi integrasi metode pembelajaran inovatif guna menumbuhkan kompetensi kritis abad ke-21, termasuk literasi digital, pemikiran kritis, kolaborasi, komunikasi, dan kreativitas, di dalam pendidikan MIPA. Analisis komprehensif terhadap studi yang ditelaah sejawat (peer-reviewed) yang diterbitkan antara tahun 2018 dan 2025 telah dilakukan untuk mengidentifikasi pendekatan pedagogis utama yang secara efektif meningkatkan keterampilan tersebut. Metode-metode seperti Pembelajaran Berbasis Proyek (Project-Based Learning/PjBL), Pembelajaran Berbasis Inkuiri (Inquiry-Based Learning/IBL), dan Pembelajaran Peningkatan Teknologi (Technology-Enhanced Learning/TEL) diidentifikasi sebagai strategi terkemuka untuk mendorong keterlibatan siswa dan mengembangkan keterampilan transversal di samping pengetahuan yang spesifik pada suatu domain. Meskipun memberikan hasil yang menjanjikan, tinjauan ini juga menyoroti berbagai tantangan yang berkaitan dengan integrasi kurikulum, kesiapan guru, dan alokasi sumber daya. Disimpulkan bahwa pendekatan holistik, yang melibatkan reformasi kurikulum, pengembangan profesional yang berkelanjutan bagi para pendidik, dan kolaborasi lintas

disiplin ilmu, sangat penting untuk menanamkan keterampilan abad ke-21 ke dalam pendidikan MIPA secara sukses. Tinjauan ini memberikan wawasan berharga mengenai bagaimana metode pembelajaran kontemporer membentuk siswa yang siap menghadapi masa depan yang dibekali dengan kompetensi yang dibutuhkan untuk menavigasi dunia yang semakin kompleks dan berbasis teknologi.

Kata Kunci: Metode Pembelajaran Inovatif, Pembelajaran Berbasis Proyek, Pendidikan STEM, Pengembangan Profesional Guru, Keterampilan Abad 21

INTRODUCTION

The integration of innovative learning methods in education has become a focal point for developing 21st-century skills, particularly in Science, Mathematics, and Technology Education (MIPA). As the global workforce rapidly adapts to technological advancements and shifting industry demands, educational systems must prepare students not only with domain-specific knowledge but also with critical transversal competencies such as problem-solving, collaboration, and digital literacy. These skills are vital for students to thrive in a world characterized by constant change and technological disruption.

The ongoing transformation in global education systems reflects the growing importance of 21st-century skills in preparing students for an increasingly complex, technology-driven world. To equip students with the necessary competencies such as critical thinking, creativity, collaboration, and digital literacy, educational institutions are turning to innovative learning methods. These methods not only promote deeper engagement with the subject matter but also foster essential life skills critical to success in the modern workforce. Despite the potential benefits of these approaches, integrating innovative pedagogies into educational practices remains fraught with challenges. These include a lack of educator training, disparities in access to technology, and the complexities of aligning curricula with rapidly changing workforce demands. The review focuses on MIPA education and examines how innovative learning methods, such as Project-Based Learning (PjBL) and Inquiry-Based Learning (IBL), foster the development of 21st-century skills in this domain. These skills are pivotal in STEM disciplines, yet their integration into educational systems faces challenges, particularly in ensuring educators are adequately trained to implement them effectively. The research problem stems from the urgent need to examine how these learning models can be effectively utilized to prepare secondary education students for the complex, technology-driven demands of the workforce.

The integration of innovative learning methods plays a critical role in developing 21st-century skills, such as critical thinking, creativity, and collaboration, among students across various educational settings. While several pedagogical approaches, such as project-based learning (PjBL) and collaborative learning, have been recognized for their potential to enhance these skills, their effectiveness remains a subject of ongoing inquiry. However, educators face significant challenges in implementing these innovative strategies, including limited resources, resistance to change, and inadequate professional development. Furthermore, there is a need to identify the most effective learning methods applicable across diverse educational contexts and to explore the impact of student-centered pedagogies on learners' cognitive and creative abilities. Addressing these challenges and understanding the role of these innovative learning methods is essential for preparing students with the competencies needed to navigate a rapidly evolving, technology-driven world.

Innovative learning methods have gained widespread recognition for their ability to enhance both technical expertise and essential soft skills. Experiential learning, for instance, emphasizes hands-on experience and encourages students to engage actively with real-world problems. This approach has been shown to significantly improve critical thinking, creativity, and collaboration skills that are essential for students' success in the modern workforce (Dighliya, 2024; Mashod & Kura, 2024). Project-based learning (PjBL), another widely adopted strategy, allows students to tackle complex, real-world challenges, fostering skills in problem-solving, teamwork, and application of knowledge to practical situations (Dighliya, 2024; Gretter & Yadav, 2016). Additionally, gamification incorporates game-like elements into learning, making the process more engaging and promoting critical thinking and strategic decision-making (Dighliya, 2024; Zamiri & Esmaeili, 2024). Furthermore, the rise of adaptive learning technologies enables personalized learning experiences, providing students with the flexibility to learn at their own

pace and enhancing their ability to manage their learning trajectory independently, an essential trait for lifelong learning (Dighliya, 2024; Songkram, 2017).

The integration of technology in MIPA education plays a pivotal role in enhancing 21st-century skills among learners. Technology offers unparalleled access to resources beyond traditional classroom settings, enabling students to explore new concepts and deepen their understanding through digital platforms (Hamzah et al., 2024; Songkram, 2017). Moreover, innovative pedagogies that leverage technology, such as flipped classrooms and collaborative online learning environments, foster active participation and student engagement, which are critical for developing cognitive skills such as problem-solving and critical thinking (Bhuttah et al., 2024; Hamzah et al., 2024). The advent of ubiquitous learning, facilitated by mobile and online platforms, has made it possible for students to access learning materials anytime and anywhere, promoting adaptability and flexibility, key traits in today's fast-paced world (Ossiannilsson & Ioannides, 2017; Songkram, 2017).

Educators play an indispensable role in the successful integration of these innovative learning methods. They serve not only as knowledge facilitators but also as guides, helping students navigate the complexities of new technologies and collaborative learning environments. As such, continuous professional development is essential to equip educators with the necessary skills to implement these innovative pedagogies and tools effectively (Ariani, 2020; Nurhidayat et al., 2024). Furthermore, educators must create inclusive and supportive learning environments that cater to diverse learners, ensuring that all students have an equal opportunity to develop 21st-century skills (Bhuttah et al., 2024).

Despite the significant benefits of integrating innovative learning methods, several challenges hinder their widespread adoption. One key challenge is the heterogeneity of studies on the subject, which complicates the synthesis of findings and limits the ability to draw generalized conclusions about the effectiveness of these methods (González-pérez & Ramírez-montoya, 2022; Zamiri & Esmaeili, 2024). Additionally, disparities in access to technology, often referred to as the digital divide, pose significant barriers, especially for students from underprivileged backgrounds who may lack equal access to digital tools and resources (Hamzah et al., 2024; Williams, 2021). Resistance to change is another hurdle; some educators may be hesitant to adopt new teaching methods due to a lack of training or familiarity with technology (Bhuttah et al., 2024; Nurhidayat et al., 2024). Previous research (Dighliya, 2024; González-Pérez & Ramírez-Montoya, 2022) has highlighted that while innovative learning methods have shown potential to improve 21st-century skills, their widespread adoption remains limited, particularly due to inadequate teacher training and limited access to technology. The novelty of this study lies in its systematic review approach to synthesizing current findings, identifying the most effective learning methods for enhancing specific skills, and proposing actionable solutions to the barriers preventing their full implementation.

The systematic review aims to provide a comprehensive analysis of these questions by drawing on recent studies and examining the practical implications of innovative pedagogies in real-world educational settings. By examining the effectiveness of different learning methods, exploring the role of student-centered approaches, and identifying the challenges educators face, this study will contribute to a more nuanced understanding of how best to integrate 21st-century skills into modern education. The findings of this review will also suggest pathways for improving educational practices, offering both theoretical insights and practical recommendations for educators, policymakers, and curriculum designers seeking to enhance the quality of education and develop future-ready students.

METHOD

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology is a widely accepted framework for conducting systematic, transparent, and reproducible reviews. It involves several key steps: developing a clear protocol that defines the research questions, inclusion/exclusion criteria, and data extraction methods; conducting a comprehensive literature search across multiple databases; screening studies based on predefined criteria; extracting relevant data from selected studies; assessing the quality of the studies to ensure high methodological rigor; synthesizing the data either qualitatively or quantitatively, often with meta-analysis; and finally, reporting the findings using the PRISMA

checklist and flow diagram to ensure transparency and clarity in the process. By following these steps, the PRISMA framework provides a structured approach for conducting literature reviews that deliver reliable, evidence-based insights into a specific research area (Mengist et al., 2020; Pati & Lorusso, 2018; Tam et al., 2019).

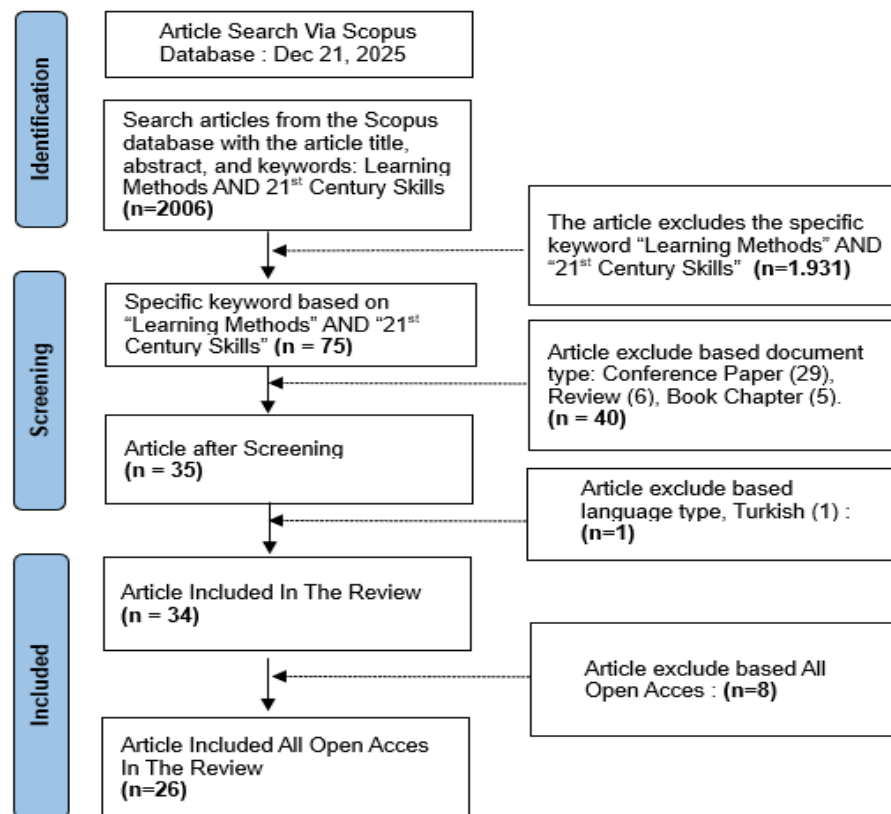


Figure 1. Systematic Literature Review information flow using PRISMA

To ensure a comprehensive and transparent synthesis of the literature on integrating innovative learning methods into 21st-century skills development, this study adopts a Systematic Literature Review (SLR) approach. The SLR method is selected because it allows researchers to systematically collect, evaluate, and synthesize existing studies, thereby reducing bias and enhancing the reliability of the findings. The initial phase of the SLR involved identifying relevant documents using the Scopus and Google Scholar databases, focusing on studies published between 2018 and 2025. Scopus was chosen for its reputation as a globally recognized platform that provides access to a broad range of scientific publications, ensuring high-quality, peer-reviewed sources. The search was conducted using the keywords "learning methods" and "21st century skills" to identify studies that address the role of educational approaches in fostering critical skills.

After identifying the initial set of documents, the subsequent step is the screening phase, which involves assessing each study against predefined inclusion and exclusion criteria to determine its relevance to the objectives of this review. Establishing explicit criteria is a core component of systematic literature reviews and is essential for ensuring transparency, consistency, and methodological rigor in the study selection process. These criteria are applied systematically to evaluate whether each document adequately addresses the research questions and aligns with the scope of the review. All bibliographic information, screening outcomes, and inclusion decisions are documented and organized in an Excel-based database, facilitating efficient filtering, verification, and auditability of the selection process, as recommended in PRISMA reporting guidelines. The screening results and documentation process are summarized in Table 1.

Table 1. Criteria Inclusion and Exclusion

Criteria	Inclusion	Exclusion
----------	-----------	-----------

Type Of Document	Journal	Conference Paper, Conference Review, Report, Book Chapter, Book.
Language	English	Non English
Accessibility	Open Access	Not Open Access
Identifier Availability	Have DOI or ISSN	Does not have a DOI or an ISSN

At this screening stage, the selection process becomes essential. We meticulously reviewed each article and ultimately excluded eight studies that did not meet our predefined criteria. These articles were removed primarily due to a lack of access to the full text or an inability to open the files. After the initial screening, we proceeded to the next step: a detailed examination. The remaining 34 documents were carefully reviewed, focusing on the title, abstract, methodology, results, and discussion sections of each article. Our primary goal was to ensure that these studies were relevant to our research on integrating innovative learning methods to develop 21st-century skills. Each document was scrutinized to evaluate its contribution to our research objectives. After this thorough evaluation, we narrowed the selection to 26 papers that explicitly discussed innovative learning methods and their impact on the development of 21st-century skills. This refined, high-quality selection ensures that our subsequent analysis is focused and meaningful, ultimately helping us develop a robust understanding of how innovative learning methods are integrated into the development of 21st-century skills.

RESULT

The integration of innovative learning methods has proven highly effective in developing essential 21st-century skills, such as critical thinking, collaboration, creativity, and digital literacy. Various studies emphasize the effectiveness of methods such as Experiential Learning, Project-Based Learning (PBL), and Gamification in fostering these skills. Experiential Learning involves real-world problem-solving, significantly enhancing students' creativity and critical thinking. Dighliya (2024) demonstrates that experiential learning engages students in authentic learning tasks that stimulate both critical thinking and creativity (Dighliya, 2024). Similarly, Project-Based Learning (PjBL) encourages collaboration and teamwork, as students work on long-term projects that require collective problem-solving, fostering essential skills needed in the modern workforce. Research by Dhir (2021) indicates that PBL is particularly effective in promoting communication, collaboration, and critical thinking (Dhir, 2021). Furthermore, Gamification, which incorporates game elements into learning, has been found to increase student motivation and engagement significantly. Gómez Niño et al. (2025) suggest that gamification enables students to develop creativity and collaboration in an enjoyable and interactive environment, leading to higher engagement and better learning outcomes (Gómez Niño et al., 2025).

The analysis of selected studies reveals the significant role that innovative learning methods play in developing 21st-century skills. A substantial number of studies focus on PBL and its impact on essential skills such as critical thinking, collaboration, and problem-solving. For instance, studies by Jelodari et al. (2025) and Galeboe et al. (2025) highlight the effectiveness of PBL in engaging students with real-world problems and fostering creativity and teamwork (Galeboe et al., 2025; Jelodari et al., 2025). Additionally, Experiential Learning and the Flipped Classroom approach are frequently discussed for their positive influence on student self-regulation and engagement. Studies have shown improvements in learners' ability to monitor and control their learning processes, particularly in scientific disciplines (Awaliyah et al., 2025; Maulana et al., 2025).

Moreover, Gamification has been shown to enhance student motivation and retention, with significant correlations between game-based learning and increased classroom participation. Aldi et al. (2025) found that gamification not only boosts engagement but also improves retention, contributing to higher levels of active learning and participation (Aldi et al., 2025). These findings indicate that integrating these innovative learning methods is highly beneficial for developing the critical skills needed in the workforce.

DISCUSSION

In terms of technology integration, many studies emphasize the pivotal role that technology plays in facilitating these innovative learning methods. Adaptive learning platforms and digital collaboration tools are integral to enhancing student engagement and promoting personalized learning experiences, both of which are essential for developing 21st-century skills. Lapisa et al. (2025) and Prahani & Dawana (2025) stress the importance of these technologies in providing tailored learning experiences that cater to individual student needs, promoting both critical thinking and creativity (Lapisa et al., 2025; Prahani & Dawana, 2025). Despite the positive outcomes, the studies also reveal significant challenges educators face in implementing these methods. Limited resources, lack of training, and time constraints are key barriers that hinder the effective use of technology and the adoption of innovative pedagogies in classrooms (Arpan et al., 2024; Avci, 2024). To fully realize the potential of these learning methods, future efforts should focus on professional development programs for educators, improved access to digital tools, and curriculum redesigns that seamlessly incorporate these strategies into teaching practices.

The integration of STEM Education and Collaborative Inquiry Learning further supports the development of 21st-century skills by combining knowledge across disciplines and fostering active participation. Megawati et al. (2025) highlight that STEM education not only strengthens students' digital literacy but also enhances their problem-solving and collaborative skills, which are essential for success in today's complex job market (Megawati et al., 2025). Collaborative Inquiry Learning, as explored by Abbas et al. (2025), promotes active engagement and reflection, which are key to developing critical thinking and intellectual curiosity among students (Abbas & Rozimela, 2025). When implemented effectively, these innovative methods provide a comprehensive approach to equipping students with the competencies they need to thrive in an increasingly digital and interconnected world.

In recent years, there has been an increasing emphasis on equipping students with the essential skills required to thrive in the 21st century. As the demands of the modern workforce evolve, educational systems worldwide are integrating innovative learning methods to foster critical skills such as creativity, collaboration, critical thinking, and digital literacy. These methods aim to prepare students for a rapidly changing world in which adaptability and problem-solving are paramount. However, the effectiveness of these learning methods in enhancing specific 21st-century skills remains a key area of inquiry. This leads us to the question:

RQ1: What innovative learning methods have been most effective in enhancing specific 21st-century skills among students in various educational settings?

Innovative learning methods have been identified as highly effective in enhancing specific 21st-century skills, such as critical thinking, creativity, collaboration, and digital literacy, among students across various educational settings. Project-Based Learning (PBL) stands out as a method that fosters critical thinking, problem-solving, and creativity, especially in STEM education. Studies show that PBL not only increases student engagement but also promotes teamwork and interdisciplinary understanding. For example, after implementing PBL in high school STEM curricula, students demonstrated significant improvements in both interest and engagement, with male students' interest rising from 29.2% to 75% and female students from 32% to 88% (To & Truong, 2025). This approach allows students to tackle real-world problems, which enhances their ability to apply knowledge in practical contexts. However, challenges such as limited resources and insufficient teacher training can hinder the full implementation of PBL, necessitating targeted teacher training and structured assessment tools to maximize its effectiveness (Rizki & Suprpto, 2024; To & Truong, 2025).

In addition to PBL, integrating technology is pivotal to enhancing 21st-century skills. Virtual Reality (VR) and gamification have been shown to significantly improve student collaboration, communication skills, and overall engagement. A systematic review by Lampropoulos and Kinshuk (2024) indicated that VR and gamified learning environments increase motivation and academic performance across various subjects, providing immersive experiences that foster social presence and collaborative learning (Lampropoulos, 2024). Similarly, Experiential Learning methods, such as internships and service learning, contribute significantly to the development of creativity, adaptability, and professional skills. These opportunities allow students to apply theoretical knowledge in real-world settings, which boosts their professional readiness and confidence (Gipson, 2024; Schneider, 2022). Lastly, Inquiry-

Based Learning (IBL) enhances digital literacy and critical thinking by encouraging students to actively seek and evaluate information, which is crucial in the digital age (Wuryandani, 2025; Yasa et al., 2024). When combined with technology, IBL strategies further improve learning outcomes by fostering an interactive, engaging, and student-centered educational experience. These innovative methods, therefore, offer a comprehensive approach to developing the skills students need to succeed in the 21st century.

Documents by year

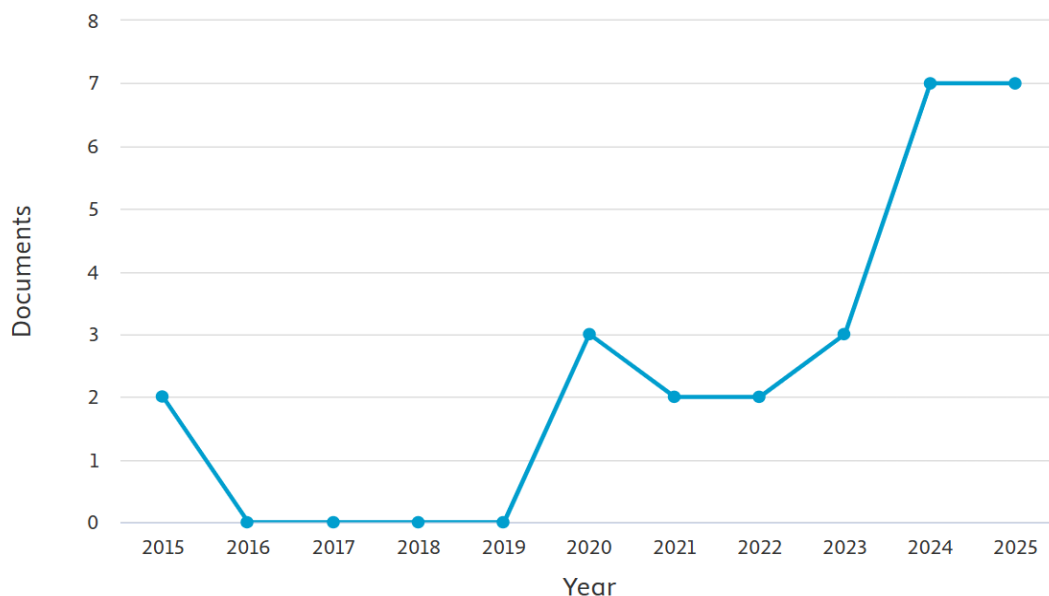


Figure 1. Number of Teaching Factory Publications (Analyze Result on Scopus)

The figure above presents a trend analysis of document publications by year, highlighting a distinct shift in research output volume. Between 2015 and 2019, the number of published documents remained minimal, with most years seeing only one or two. This early stagnation could indicate limited research activity or a nascent stage of investigation in the field during these years. Starting in 2020, there has been a marked increase in the number of documents, signaling a significant turning point in the field. The data shows a rapid surge in publications from 2020 to 2025, with the number of documents spiking sharply in 2020 and continuing to grow in subsequent years. This increase might be attributed to several factors, such as emerging trends, increased research funding, or heightened interest in the subject matter, possibly spurred by external events like global challenges or technological advancements. From 2023 onward, the number of publications stabilizes at a high level, suggesting the research area has entered a period of sustained activity. It is worth noting that the steep rise in 2020 could indicate a pivotal moment in research interest, possibly reflecting a shift in academic or policy priorities, a response to technological innovations, or greater collaboration in the field. Overall, the graph illustrates not only the growth in research volume but also hints at key historical or external factors that influenced the surge in academic output.

RQ2: How do student-centered pedagogies, such as project-based learning and collaborative learning, impact the development of critical thinking and creativity in learners?

Student-centered pedagogies, including Project-Based Learning (PBL) and Collaborative Learning, have been widely recognized for their positive impact on students' critical thinking and creativity. These methods align closely with Constructivist Learning Theory, which emphasizes that learners actively construct their knowledge through hands-on experiences. PBL, for example, engages students in real-world projects that require problem-solving, critical thinking, and creative solutions, which enhances their cognitive abilities (Al-Kamzari & Alias, 2025; Syrma, 2021). Collaborative learning, on the other hand, focuses on teamwork and communication, which are essential for developing critical thinking skills as students work together to analyze, evaluate,

and create solutions. Research has shown that collaborative environments can significantly improve students' ability to think critically and creatively by encouraging them to reflect on and discuss diverse perspectives (Kurniawan, 2024; Salendab & Tago, 2025). These pedagogies are supported by the Competency-Based Education framework, which tailors learning experiences to foster specific competencies, including critical thinking and creativity, through personalized approaches (Kantanen, 2025; Salendab & Tago, 2025).

Empirical evidence supports the effectiveness of these pedagogies across various educational contexts. In primary and secondary education, PBL has been found to improve student engagement and curiosity, leading to stronger critical thinking and creativity (Al-Kamzari & Alias, 2025; Davletova et al., 2025). For example, in secondary education, students who participated in PBL showed significant improvement in their interest in STEM subjects, with engagement levels rising substantially. In higher education, PBL and collaborative learning are particularly effective in preparing students for real-world challenges, as they engage in complex, authentic projects that not only enhance academic performance but also promote essential life skills such as leadership and innovation (Ahmad Zukarnain et al., 2020; Satyawati & Agustin, 2025). Additionally, experiential learning opportunities such as internships and service learning have been shown to significantly enhance students' creativity and adaptability by applying theoretical knowledge in real-world contexts, further fostering critical thinking (Ahmad Zukarnain et al., 2020; Satyawati & Agustin, 2025). Overall, student-centered pedagogies, supported by these theoretical frameworks and empirical findings, play a crucial role in developing critical thinking and creativity, essential skills for success in the 21st century.

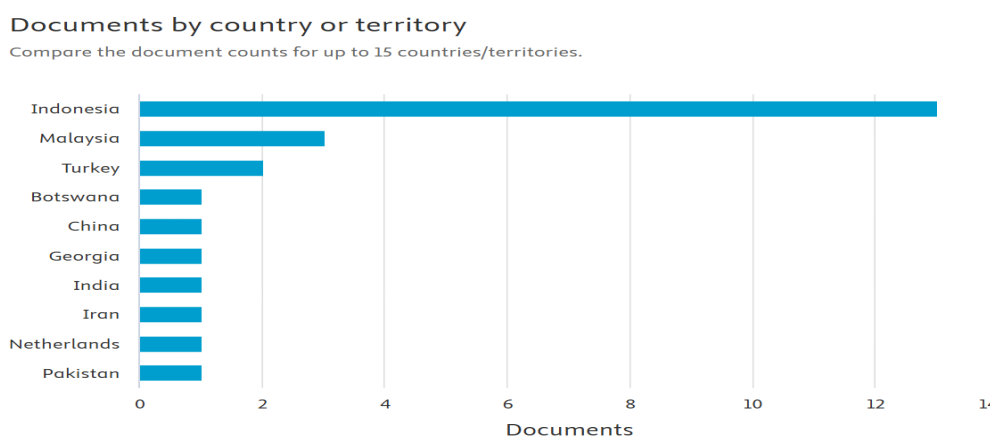


Figure 2. Top 10 Country Publications (Analyze Result on Scopus)

Figure 2 presents the distribution of document publications by country or territory, based on data from Scopus. The chart clearly shows that Indonesia has the most publications, with a significantly higher count than other countries. This suggests a dominant presence of research activity in Indonesia within the dataset. Malaysia and Turkey follow, with more modest publication counts, reflecting notable research contributions from these countries as well. Other countries, such as Botswana, China, Georgia, India, Iran, the Netherlands, and Pakistan, are also represented, but with comparatively fewer publications. The significant number of publications from Indonesia is likely a combination of national educational policies promoting 21st-century skills, growing academic infrastructure, and regional research focus. These factors, along with Indonesia's increasing engagement in international research networks, have likely led to its dominant presence in the dataset. This could serve as a model for other countries seeking to enhance their academic contributions to the field of 21st-century skills.

Figure 3 presents a network visualization of countries created with VOSviewer, showing the relative prominence of countries in the dataset. This heatmap further reinforces the findings in Figure 2, highlighting Indonesia's dominant position in publication activity. The bright yellow area representing Indonesia indicates a high concentration of documents, reflecting the country's significant research output. Malaysia and Turkey also appear in the visualization, with green areas indicating their presence but at lower intensity than Indonesia. This network visualization provides a clear, spatial representation of the geographical distribution of research, confirming

Indonesia's leading role in this academic field while showcasing the contributions from Malaysia and Turkey in a smaller capacity.

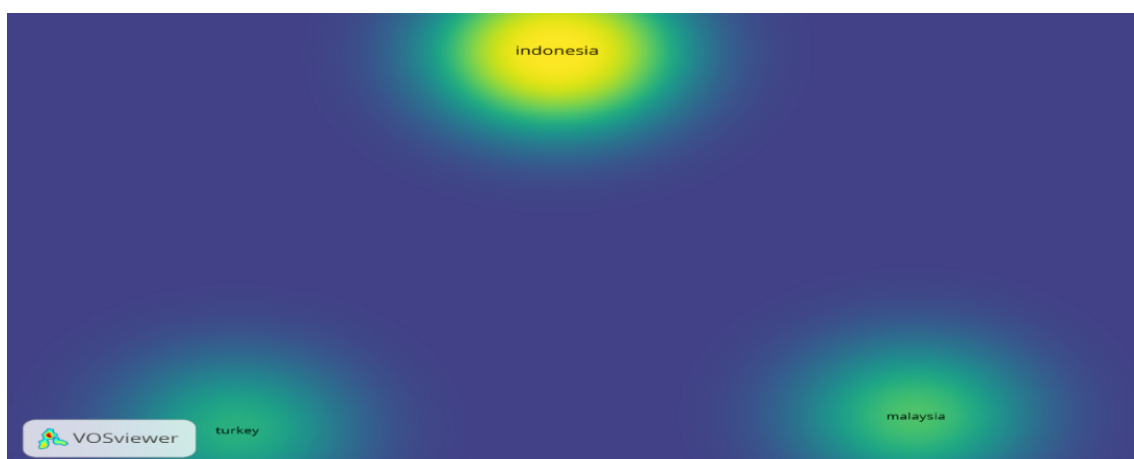


Figure 3. Network Country Visualization (Result VOS Viewer)

Figure 4 illustrates the distribution of document publications by institutional affiliation, highlighting the key contributors to academic research in the field. The chart showcases the significant roles of various universities, particularly those from Indonesia, in shaping the research landscape. The data reveals that Universitas Negeri Malang, Universitas Negeri Makassar, and Universitas Jambi are among the top contributors, reflecting their prominent involvement in the scholarly community. This figure emphasizes the importance of academic institutions in driving research output, particularly in Indonesia, where state universities and Islamic institutions, such as Institut Agama Islam Negeri (IAIN), also play significant roles in advancing knowledge. These findings are aligned with the broader trend of increasing research activity in the region, as observed in Figures 2 and 3.

Documents by affiliation

Compare the document counts for up to 15 affiliations.

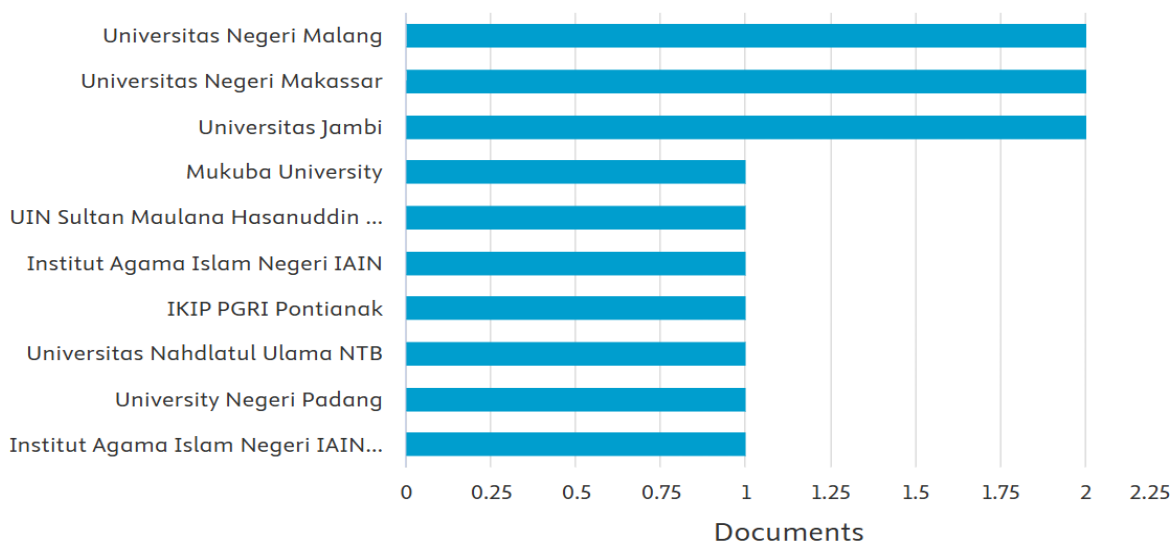


Figure 4. Network Country Visualization (Analyze Result On Scopus)

Figure 4 provides a clear visualization of the distribution of documents by affiliation, showing the number of publications associated with each institution. Universitas Negeri Malang emerges as the leading contributor, followed closely by Universitas Negeri Makassar and Universitas Jambi, highlighting their prominent roles in academic research. These institutions are well-established in Indonesia and have extensive research programs that drive scholarly activity. The chart also includes other institutions such as Mukuba University, UIN Sultan Maulana

Hasanuddin, and Institut Agama Islam Negeri (IAIN), indicating a diverse range of contributors, including both state and Islamic institutions. The presence of IKIP PGRI Pontianak, Universitas Nahdlatul Ulama NTB, and University Negeri Padang further demonstrates the breadth of academic engagement in the field.

The prominence of Indonesian universities in this dataset reflects the country's growing academic landscape, as evidenced by rising research output. These affiliations highlight a shift toward more inclusive, collaborative, and diverse research practices, particularly in Southeast Asia, where higher education institutions are actively contributing to global knowledge production. The significant contributions of the Institut Agama Islam Negeri (IAIN) underscore the growing impact of Islamic universities in the region, extending beyond Islamic studies into broader academic fields. This dataset illustrates a robust network of academic institutions fostering critical research, aligning with the global trend of expanding university research contributions across various domains, particularly in Southeast Asia's evolving educational infrastructure.

Figure 5 provides an overview of document publications per year by source, highlighting the distribution of academic articles across various journals. The chart allows us to compare the number of documents published by key journals, providing insights into the field's academic impact and trends over time. It illustrates the growth or stability in research output across different sources, offering a clearer understanding of the journals that have been central to this body of research from 2015 to 2025.

Documents per year by source

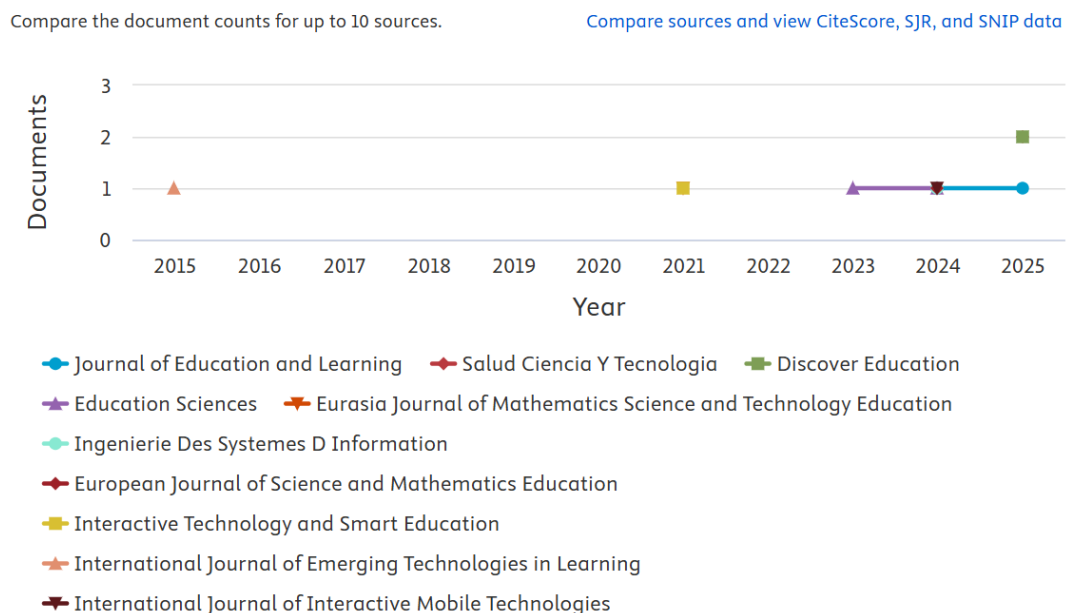


Figure 5. Number of Articles by Sources (Top 10 Sources on Scopus)

Figure 5 presents a detailed visualization of the number of documents published by year across the top 10 sources, as indexed in Scopus. The graph provides valuable insights into the publication patterns of various academic journals in the field, clearly indicating the years when specific sources experienced surges in publication. The Journal of Education and Learning has been the most consistent source over the years, with a steady increase in publications from 2020 to 2025, underscoring its prominent role in advancing educational research. On the other hand, Salud Ciencia Y Tecnología and Discover Education exhibit sporadic publication patterns with occasional spikes, suggesting fluctuations in research output volume.

In contrast, sources such as Eurasia Journal of Mathematics, Science and Technology Education and European Journal of Science and Mathematics Education show a more recent rise in publications, beginning around 2021, which could signal growing interest in their respective fields. The presence of sources such as Ingénierie des Systèmes d'Information, Interactive Technology, and Smart Education also underscores the integration of technology and innovation in educational research, a trend with increasing relevance in recent years. This data highlights a trend towards interdisciplinary research, as journals covering a wide range of educational

methods, from technology to mathematics and science education, are gaining prominence. These shifts suggest a growing convergence across educational domains, driven by technological advancements and emerging trends. The chart thus reflects the dynamic, evolving nature of educational research, particularly in response to global changes and technological advancements over the last few years.

Figure 6 illustrates the distribution of document publications by author, highlighting the top contributors in the dataset. Hadiyanto, H., Haviz, M., and Maris, I.M. emerge as the leading authors, each with the highest number of publications, reflecting their central role in this area of research. Rifdarmon, Abdullah, N., and Abesadze, S. follow closely behind, contributing significantly to the overall body of work. The relatively even distribution of documents among these authors suggests a collaborative research environment in which multiple contributors share a balanced level of involvement in academic publishing. Authors such as Adnan, Adripen, Alamsyah, and Aldi S. also made valuable contributions, though with fewer documents. This figure highlights the collaborative nature of the research, with a concentrated group of scholars leading the field's publications.

Documents by author

Compare the document counts for up to 15 authors.

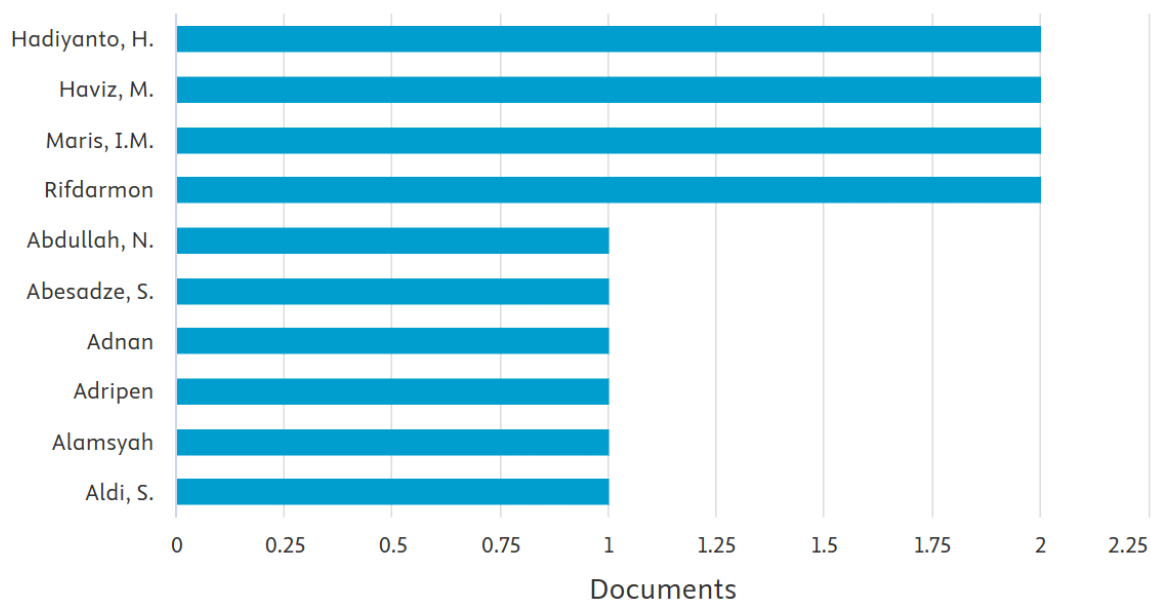


Figure 6. Count of Publications by Author (Top 10 Authors on Scopus)

RQ3: What challenges do educators face in implementing innovative learning methods, and what strategies can be employed to overcome these barriers to effectively foster 21st-century skills?

Educators face several challenges when implementing innovative learning methods, particularly those that integrate technology into their teaching practices. These challenges can be categorized as individual, institutional, and systemic barriers. At the individual level, teachers often face issues such as a lack of digital competence, which can hinder their ability to use new technologies in the classroom confidently (Awang, Zulkifli, et al., 2025; Chen et al., 2026). Additionally, resistance to change is a common issue, as many educators are accustomed to traditional teaching methods and may be reluctant to adopt innovative approaches due to fears of inadequacy or unfamiliarity with new pedagogies (Awang, Zulkifli, et al., 2025; Chen et al., 2026). On the institutional level, lack of leadership support and resource limitations are significant obstacles. Teachers may feel isolated without strong backing from school leadership, and insufficient access to technological tools and resources further impedes the effective implementation of innovative methods (Awang, Hamzah, et al., 2025; Awang, Zulkifli, et al., 2025). Systemic barriers include the absence of supportive policies that encourage innovation and socio-cultural resistance to new teaching practices, particularly in regions where traditional views of education still dominate (Awang, Zulkifli, et al., 2025; Wilson, 2016).

To overcome these challenges, several strategies can be employed. Professional development programs focused on technology integration and pedagogical innovation are crucial for equipping educators with the skills and confidence to implement new teaching methods (Gruich, 2014; Velmurugan et al., 2025). Additionally, schools should provide institutional support, including creating a shared vision for technology integration and ensuring adequate resource allocation for teachers to engage with innovative methods effectively (Hew & Brush, 2007; Park & Ertmer, 2008). Cultural change is also necessary, encouraging a growth mindset among educators, where experimentation and learning from failure are valued, and peer support networks are established (Awang, Zulkifli, et al., 2025; Wilson, 2016). Lastly, policy development is essential for providing clear guidelines and support for innovation, including the creation of flexible curricula that allow for the integration of new teaching strategies and technologies (Awang, Hamzah, et al., 2025, 2025). By addressing these barriers and employing these strategies, educators can effectively foster 21st-century skills, preparing students for the demands of an increasingly digital and interconnected world.

Figure 7 presents a network visualization of key concepts related to 21st-century skills. The map, generated with VOSviewer, provides an insightful analysis of how these skills relate to other educational and professional competencies. It highlights important concepts such as critical thinking, collaboration, and project-based learning, while also illustrating the relationship between higher education and skills development. This visualization helps us better understand the interconnectedness of these skills within the broader educational context.

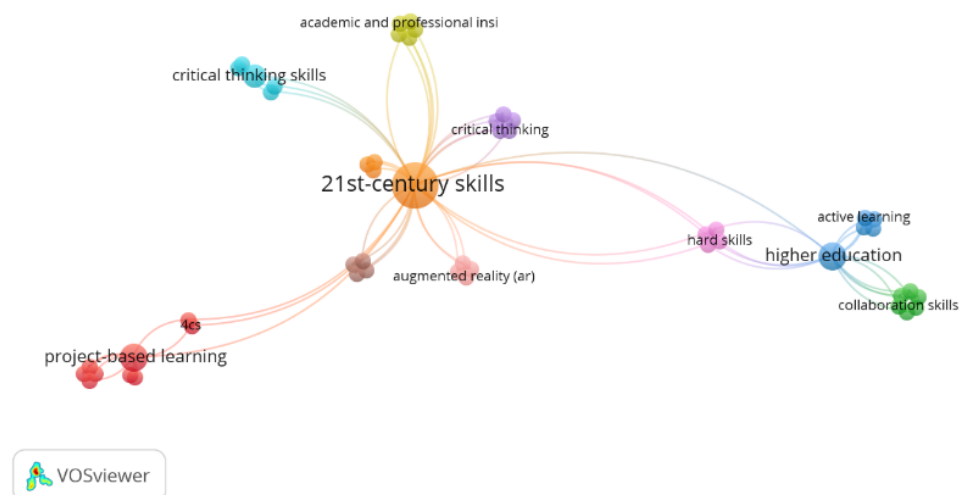


Figure 7. Co-Occurrence Framework and Representation of Key Terms(Result VOS Viewer)

Figure 7 visualizes the complex relationships among core concepts in the development of 21st-century skills. The central node, 21st-century skills, is clearly connected to several important elements, including critical thinking, collaboration, and hard skills. These connections emphasize the foundational role of critical thinking and collaboration in modern education. The proximity of higher education to these skills underscores the critical importance of universities and academic institutions in shaping the next generation of learners equipped with these essential competencies.

Project-based learning (PBL), located in the lower-left section of the diagram, is closely associated with 21st-century skills, particularly in fostering problem-solving, creativity, and teamwork. Additionally, augmented reality (AR) appears to be a critical tool for enhancing the learning experience, reflecting the growing trend of integrating technology into educational practices. The relationship between academic and professional insights and core skills further underscores the importance of bridging theoretical knowledge and practical application.

This network suggests that a holistic approach, integrating various educational strategies and technologies to develop 21st-century skills, is key to preparing students for the demands of

the modern workforce. It also indicates the increasing convergence of digital tools and collaborative pedagogies in shaping the future of education.

Table 2. Keyword by Author (Analyze Result on Scopus)

Rank	Keyword	Total Link Strength
1.	21 st Century Skills	33
2.	Higher Education	19
3.	Project-Based Learning	9
4.	Active Learning	8
5.	Flipper Classroom	8
6.	Flipped Learning	8
7.	Collaboration Skills	6
8.	Communication Skills	6
9.	Critical Thinking Skills	14
10.	Digital Learning	14

The integration of innovative learning methods has shown significant promise in enhancing key 21st-century skills, including critical thinking, collaboration, creativity, and digital literacy. Project-Based Learning (PBL) is one of the most widely adopted methods and is particularly effective in promoting problem-solving, critical thinking, and creativity. The method allows students to engage with real-world problems, fostering teamwork and interdisciplinary collaboration. Studies have demonstrated that students participating in PBL have increased interest and engagement, particularly in STEM subjects, as they are encouraged to explore practical applications of their knowledge. In addition to PBL, gamification and experiential learning have also gained attention for their role in enhancing student engagement and creativity. Gamification, by integrating game-like elements into educational tasks, has been found to significantly increase motivation and engagement, creating an interactive learning environment that encourages students to think critically and collaborate effectively. Meanwhile, experiential learning, which puts students in hands-on learning environments, boosts critical thinking and creativity by allowing them to solve real-world problems.

The integration of technology, particularly through tools such as virtual reality (VR), adaptive learning platforms, and augmented reality (AR), has proven crucial to enhancing 21st-century skills. These technologies enable personalized learning experiences and provide immersive environments where students can interact with content. Studies have shown that VR and AR not only boost student engagement but also enhance collaboration and communication skills by providing virtual spaces for learners to collaborate. In addition, adaptive learning technologies cater to individual student needs, helping them master skills at their own pace while promoting critical thinking and problem-solving abilities. Despite the promising results of these learning methods, challenges such as limited access to technology, insufficient teacher training, and resistance to adopting new pedagogies remain prevalent. Addressing these barriers will require a multifaceted approach, including professional development for teachers, increased resource allocation, and policy adjustments to support the integration of technology and student-centered learning methods across educational systems.

CONCLUSION

In conclusion, integrating innovative learning methods, such as PBL, gamification, and technology-enhanced learning, is pivotal to developing students' critical 21st-century skills. These pedagogies promote active learning, collaboration, and creativity, which are essential for preparing students for the evolving demands of the modern workforce. However, the successful adoption of these methods faces several challenges, including resource limitations, resistance to change, and the need for ongoing professional development for teachers. By overcoming these barriers, educational systems can more effectively integrate 21st-century skills into the curriculum, ultimately equipping students with the competencies necessary to thrive in a rapidly changing, technology-driven world. The future success of these pedagogies hinges on continuous

support from educational institutions, policy reforms, and the fostering of an adaptive, growth-oriented culture within classrooms.

RECOMMENDATION

Based on the findings of this study, it is recommended that educators and curriculum developers enhance continuous professional development programs focusing on digital competence and innovative teaching methodologies, such as Project-Based Learning (PjBL) and gamification, while ensuring better access to technological resources to support the development of 21st-century skills. The curriculum should be more flexible to accommodate personalized and project-based learning approaches that engage students in real-world problem-solving. Additionally, the development of integrated learning models that combine technology and digital collaboration elements should be prioritized, alongside further longitudinal studies to assess the long-term impact of technology on critical skills such as creativity and collaboration. Research should also examine socio-cultural barriers to implementing technology-based learning across various educational contexts, with strategies to overcome resistance to change. Educational policies that support technology integration, provide funding for resources and training, and promote stakeholder collaboration are crucial for the successful implementation of innovative teaching practices.

ACKNOWLEDGEMENT

The authors express their deepest appreciation to the Doctoral Program in Educational Science and the Master's Program in Science Education (Magister Pendidikan MIPA) at Indraprasta PGRI University Jakarta. The programs provided the researchers with essential assistance and vital resources during their research work. The research team achieved its goal thanks to the expert knowledge and dedicated efforts of its members.

REFERENCES

- Abbas, M. F. F., & Rozimela, Y. (2025). Implementing A Collaborative-Inquiry Learning Model To Foster 21st Century Critical Thinking: A Validity And Practicality Study For Sustainable Human Development. *Seminars In Medical Writing And Education*, 4. Scopus. <https://doi.org/10.56294/Mw2025724>
- Ahmad Zukarnain, Z., Wan Husain, W. S., Che Hassan, S. H., Nik Kamaruzaman, N. N., Mohd Zin, N. A., & Wan Aziz, W. A. H. (2020). Examining Students' Aptitude Using Project-Based Learning Through University-Industry Collaboration. In Wan Yaacob W.F. (Ed.), *J. Phys. Conf. Ser.* (Vol. 1496, Issue 1). Institute Of Physics Publishing; Scopus. <https://doi.org/10.1088/1742-6596/1496/1/012013>
- Aldi, S., Azis, A. A., & Syamsul Bahri, H. S. (2025). The Influence Of Saldi Biology Learning Model Integrated With TPACK On 4C Skills And Student Learning Independence. *Salud, Ciencia Y Tecnologia*, 5. Scopus. <https://doi.org/10.56294/Saludcyt20251931>
- Al-Kamzari, F., & Alias, N. (2025). A Systematic Literature Review Of Project-Based Learning In Secondary School Physics: Theoretical Foundations, Design Principles, And Implementation Strategies. *Humanities And Social Sciences Communications*, 12(1). Scopus. <https://doi.org/10.1057/S41599-025-04579-4>
- Ariani, R. (2020). Analysis Of Interactive Media Integrated Natural Science With Energy Themes In The Life Of Using Integrated Types That Integrate Of Learning For The 21st Century. In Ramli Null, F. Of M. And N. S. Universitas Negeri Padang Department Of Physics, Jl. Prof. Dr. Hamka, Air Tawar, Padang, Yohandri Null, F. Of M. And N. S. Universitas Negeri Padang Department Of Physics, Jl. Prof. Dr. Hamka, Air Tawar, Padang, Wurster C., Abu Bakar S., & F. S. Dan M. Universiti Pendidikan Sultan Idris 35900 Tanjung Malim Perak (Eds.), *J. Phys. Conf. Ser.* (Vol. 1481, Issue 1). Institute Of Physics Publishing; Scopus. <https://doi.org/10.1088/1742-6596/1481/1/012048>
- Arpan, M., Ambiyar, A., Ridwan, U., & Nasution, A. (2024). Augmented Reality Solutions By Utilizing Mobile Technology For Enhanced Skill Development. *International Journal Of*

- Interactive Mobile Technologies*, 18(20), 129–141. Scopus. <https://doi.org/10.3991/ijim.V18i20.50809>
- Avci, F. (2024). Effects Of Robotic Module-Supported Experimental Activities With The Cooperative Learning Method On Student Achievement, 21st-Century Skills, And Students' Opinions. *Journal Of Computer Assisted Learning*, 40(5), 2325–2338. Scopus. <https://doi.org/10.1111/jcal.13030>
- Awaliyah, N., Habiddin, H., Sumari, S., Yahmin, Y., & Munzil, M. (2025). The Profile Of Chemistry Students Pedagogical Knowledge, Chemical Knowledge, And Entrepreneurial Knowledge. *Multidisciplinary Reviews*, 8(10). Scopus. <https://doi.org/10.31893/multirev.2025340>
- Awang, N. E., Hamzah, M. I., & Zulkifli, H. (2025). Barriers To Implementing Innovative Pedagogy: A Systematic Review Of Challenges And Strategic Solutions. *International Journal Of Learning, Teaching And Educational Research*, 24(3), 679–698. Scopus. <https://doi.org/10.26803/ijlter.24.3.32>
- Awang, N. E., Zulkifli, H., & Hamzah, M. I. (2025). Factors Affecting Teachers' Implementation Of Innovative Pedagogies: A Systematic Literature Review. *International Journal Of Learning, Teaching And Educational Research*, 24(3), 366–382. Scopus. <https://doi.org/10.26803/ijlter.24.3.18>
- Bhuttah, T. M., Xusheng, Q., Abid, M. N., & Sharma, S. (2024). Enhancing Student Critical Thinking And Learning Outcomes Through Innovative Pedagogical Approaches In Higher Education: The Mediating Role Of Inclusive Leadership. *Scientific Reports*, 14(1). Scopus. <https://doi.org/10.1038/s41598-024-75379-0>
- Chen, C.-H., Fei, H.-Y., & Tsai, C.-C. (2026). Hierarchical Analysis Of In-Service Teachers' Barriers To Technology-Integrated Instruction: A Review Of 2000–2024 Publications. *Computers And Education*, 242. Scopus. <https://doi.org/10.1016/j.compedu.2025.105509>
- Davletova, A., Nazarova, A., Alzhanova, A., & Lazareva, Y. (2025). How Does Student Creativity Depend On Teaching Methods At The Institute? Modern Information Technologies For Education And Creativity As Manifestations Of The Specifics Of The Psyche. *Cogent Education*, 12(1). Scopus. <https://doi.org/10.1080/2331186X.2025.2482502>
- Dhir, H. K. (2021). Handbook Of Research On Barriers For Teaching 21st Century Competencies And The Impact Of Digitalization. In *Handb. Of Research On Barriers For Teach. 21st-Century Competencies And The Impact Of Digit.* (P. 468). IGI Global; Scopus. <https://doi.org/10.4018/978-1-7998-6967-2>
- Dighliya, B. (2024). Innovative Teaching Methods For Skill Development. In *Insights Into International High. Education Leadersh. And The Skills Gap* (Pp. 229–250). IGI Global; Scopus. <https://doi.org/10.4018/979-8-3693-3443-0.Ch009>
- Galeboe, K. A., Moalosi, R., Rapitsenyane, Y., & Ruele, V. (2025). What Is The Impact Of Using Design And Technology Pedagogy To Support The Attainment Of 21st-Century Skills? *Discover Education*, 4(1). Scopus. <https://doi.org/10.1007/s44217-025-00604-5>
- Gipson, C. M. (2024). Service-Learning. In *Encyclopedia Of Sport Management, Second. Edition* (Pp. 860–861). Edward Elgar Publishing Ltd.; Scopus. <https://doi.org/10.4337/9781035317189.Ch503>
- Gómez Niño, J. R., Árias Delgado, L. P., Chiappe, A., & Ortega González, E. (2025). Gamifying Learning With AI: A Pathway To 21st-Century Skills. *Journal Of Research In Childhood Education*, 39(4), 735–750. Scopus. <https://doi.org/10.1080/02568543.2024.2421974>
- González-Pérez, L. I., & Ramírez-Montoya, M. S. (2022). Components Of Education 4.0 In 21st Century Skills Frameworks: Systematic Review. *Sustainability (Switzerland)*, 14(3). Scopus. <https://doi.org/10.3390/su14031493>
- Gretter, S., & Yadav, A. (2016). Computational Thinking And Media & Information Literacy: An Integrated Approach To Teaching Twenty-First Century Skills. *Techtrends*, 60(5), 510–516. Scopus. <https://doi.org/10.1007/s11528-016-0098-4>
- Gruich, M. R. (2014). Defining Professional Development For Technology. In *Adult And Contin. Educ.: Concepts, Methodol., Tools, And Appl.* (Vols. 1–4, Pp. 376–395). IGI Global; Scopus. <https://doi.org/10.4018/978-1-4666-5780-9.Ch022>
- Hamzah, F., Abdullah, A. H., & Ma, W. (2024). Advancing Education Through Technology Integration, Innovative Pedagogies And Emerging Trends: A Systematic Literature

- Review. *Journal Of Advanced Research In Applied Sciences And Engineering Technology*, 41(1), 44–63. Scopus. <https://doi.org/10.37934/Araset.41.1.4463>
- Hew, K. F., & Brush, T. (2007). Integrating Technology Into K-12 Teaching And Learning: Current Knowledge Gaps And Recommendations For Future Research. *Educational Technology Research And Development*, 55(3), 223–252. Scopus. <https://doi.org/10.1007/S11423-006-9022-5>
- Jelodari, Z., Mohammadi Zenouzagh, Z. M., & Hashamdar, M. (2025). Exploring PBL And E-PBL: Implications For 21st-Century Skills In EFL Education. *Discover Education*, 4(1). Scopus. <https://doi.org/10.1007/S44217-025-00773-3>
- Kantanen, H. (2025). Pedagogies For Innovative Competencies. In *Elgar Encyclopedia Of Innovation Management* (Pp. 47–50). Edward Elgar Publishing Ltd.; Scopus. <https://doi.org/10.4337/9781035306459.00021>
- Kurniawan, K. (2024). Enhancing 21st-Century Writing Skills Through A Reflective Collaborative Learning Model Based On Critical Thinking. *Pakistan Journal Of Life And Social Sciences*, 22(2), 12393–12400. Scopus. <https://doi.org/10.57239/PJLSS-2024-22.2.00886>
- Lampropoulos, G. (2024). Virtual Reality And Gamification In Education: A Systematic Review. *Educational Technology Research And Development*, 72(3), 1691–1785. Scopus. <https://doi.org/10.1007/S11423-024-10351-3>
- Lapisa, R., Syaifullah, L., Maksum, H., Irfan, D., & Nanda, I. (2025). Digital Technology Innovation In TVET: Rifdarmon-Based E-Learning Model Enhancing Learning Outcomes And 4C Skills. *Salud, Ciencia Y Tecnologia*, 5. Scopus. <https://doi.org/10.56294/Saludcyt20251491>
- Mashod, H., & Kura, K. M. (2024). Individual Differences As Determinants Of Graduate Employability In Brunei Darussalam. In *Insights Into International High. Education Leadersh. And The Skills Gap* (Pp. 209–228). IGI Global; Scopus. <https://doi.org/10.4018/979-8-3693-3443-0.Ch008>
- Maulana, I., Budiarto, M. K., & Qodr, T. S. (2025). Assessing Critical Thinking Skills In Vocational School Students During Hybrid Learning. *Journal Of Education And Learning*, 19(1), 232–240. Scopus. <https://doi.org/10.11591/Edulearn.V19i1.21754>
- Megawati, R., Subchan, W., Wahyuni, D., & Tanta, T. (2025). STEM As A Catalyst For Education 5.0 To Improve 21st Century Skills In College Students: A Literature Review. *Open Education Studies*, 7(1). Scopus. <https://doi.org/10.1515/Edu-2025-0117>
- Mengist, W., Soromessa, T., & Legese, G. (2020). Method For Conducting Systematic Literature Review And Meta-Analysis For Environmental Science Research. *Methodsx*, 7. Scopus. <https://doi.org/10.1016/J.Mex.2019.100777>
- Nurhidayat, E., Mujiyanto, J., Yuliasri, I., & Hartono, R. (2024). Technology Integration And Teachers' Competencies In The Development Of 21st-Century Learning In EFL Classrooms. *Journal Of Education And Learning*, 18(2), 342–349. Scopus. <https://doi.org/10.11591/Edulearn.V18i2.21069>
- Ossiannilsson, E., & Ioannides, N. (2017). Towards A Framework And Learning Methodology For Innovative Mobile Learning: A Theoretical Approach. In Souleles N., Papadopoulos G., & Loizides F. (Eds.), *ACM Int. Conf. Proc. Ser.* Association For Computing Machinery; Scopus. <https://doi.org/10.1145/3136907.3136929>
- Park, S. H., & Ertmer, P. A. (2008). Examining Barriers In Technology-Enhanced Problem-Based Learning: Using A Performance Support Systems Approach. *British Journal Of Educational Technology*, 39(4), 631–643. Scopus. <https://doi.org/10.1111/J.1467-8535.2008.00858.X>
- Pati, D., & Lorusso, L. N. (2018). How To Write A Systematic Review Of The Literature. *Health Environments Research And Design Journal*, 11(1), 15–30. Scopus. <https://doi.org/10.1177/1937586717747384>
- Prahani, B. K., & Dawana, I. R. (2025). Exploring The Potential Of Technology In Physics Education: Current Research And Innovation Trends To Support 21st Century Skills. *Perspektiv Nauki I Obrazovania*, 73(1), 349–361. Scopus. <https://doi.org/10.32744/Pse.2025.1.23>
- Rizki, I. A., & Suprpto, N. (2024). Project-Oriented Problem-Based Learning Through SR-STEM To Foster Students' Critical Thinking Skills In Renewable Energy Material. *Journal Of*

- Science Education And Technology*, 33(4), 526–541. Scopus. <https://doi.org/10.1007/S10956-024-10102-2>
- Salendab, F. A., & Tago, K. L. (2025). Innovative Approaches To Revolutionize Student-Centered Learning In The 21st Century. In *Emerg. Trends, Glob. Perspect., And Syst. Transform. In AI* (Pp. 33–81). IGI Global; Scopus. <https://doi.org/10.4018/979-8-3373-5102-5.Ch002>
- Satyawati, S. T., & Agustin, A. (2025). Fostering Twenty-First-Century Skills: An Analysis Of The Critical And Creative Thinking In Research-Based Learning Model. *International Journal Of Learning In Higher Education*, 32(2), 47–65. Scopus. <https://doi.org/10.18848/2327-7955/CGP/V32i02/47-65>
- Schneider, J. (2022). Impacting And Influencing The System To Support Student Career Readiness, Voice, And Efficacy: Development Of An Experiential Service-Learning Course. In *Res. Anthol. On Racial Equity, Identity, And Privil.* (Pp. 212–227). IGI Global; Scopus. <https://doi.org/10.4018/978-1-6684-4507-5.Ch011>
- Songkram, N. (2017). Online Course Design For Creativity And Innovative Skills In Virtual Cultural ASEAN Community: From Research To Empirical Practice. *International Journal Of Emerging Technologies In Learning*, 12(1), 4–20. Scopus. <https://doi.org/10.3991/IJET.V12i01.6032>
- Syrma, T. (2021). Η Σημασία Της Φοιτητοκεντρικής Μάθησης Στην Ανάπτυξη Της Κριτικής Σκέψης. *Academia (Greece)*, 2021(23–24), 226–245. Scopus. <https://doi.org/10.26220/Aca.3607>
- Tam, W. W. S., Tang, A., Woo, B., & Goh, S. Y. S. (2019). Perception Of The Preferred Reporting Items For Systematic Reviews And Meta-Analyses (PRISMA) Statement Of Authors Publishing Reviews In Nursing Journals: A Cross-Sectional Online Survey. *BMJ Open*, 9(4). Scopus. <https://doi.org/10.1136/Bmjopen-2018-026271>
- To, N. D. H., & Truong, V. L. (2025). Potential And Challenges Of Teaching STEM Through Project-Based Learning. *Proc. - Int. STEM Educ. Conf., Istem-Ed*. Proceedings - 2025 10th International STEM Education Conference, Istem-Ed 2025. Scopus. <https://doi.org/10.1109/Istem-Ed65612.2025.11129297>
- Velmurugan, R., Sudarvel, J., Bhuvaneswari, R., & Thirumalaisamy, R. (2025). Professional Development Focused On Teaching And Learning In Online Environments. In *Enhanc. The Scholarsh. Of Teach. And Learn. In Online Learn. Environ.* (Pp. 95–118). IGI Global; Scopus. <https://doi.org/10.4018/979-8-3693-7595-2.Ch005>
- Williams, R. (2021). Innovative Instructional Methods Integrating 21st-Century Competencies. In *Handb. Of Research On Barriers For Teach. 21st-Century Competencies And The Impact Of Digit.* (Pp. 272–292). IGI Global; Scopus. <https://doi.org/10.4018/978-1-7998-6967-2.Ch015>
- Wilson, N. (2016). Sociotechnical And Pedagogical Barriers To Technology Integration. In *Adv. Next-Generation Teach. Educ. Through Digit. Tools And Appl.* (Pp. 19–37). IGI Global; Scopus. <https://doi.org/10.4018/978-1-5225-0965-3.Ch002>
- Wuryandani, W. (2025). Transforming Primary Education: Balancing Social Skills And Academic Achievement Through Global Inquiry-Based Learning Models. *Frontiers In Education*, 10. Scopus. <https://doi.org/10.3389/Feduc.2025.1512274>
- Yasa, A. D., Rahayu, S., Koes, S. K., & Ekawati, R. (2024). Evaluating The Impact Of Smart Learning-Based Inquiry On Enhancing Digital Literacy And Critical Thinking Skills. *Ingenierie Des Systèmes d'Information*, 29(1), 219–233. Scopus. <https://doi.org/10.18280/Isi.290122>
- Zamiri, M., & Esmaeili, A. (2024). Strategies, Methods, And Supports For Developing Skills Within Learning Communities: A Systematic Review Of The Literature. *Administrative Sciences*, 14(9). Scopus. <https://doi.org/10.3390/Admsci14090231>

