Implementing 21st Century Skills in Indonesian Private High Schools: Challenges, Strategies, and Student Outcomes

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Abstract, *The Industrial Revolution 4.0 has drastically changed the global employment landscape, necessitating the comprehensive development of 21st-century skills in education systems. This study examines how private high schools in Indonesia implement 21st-century skills, focusing on the barriers faced, the strategies used, and their impact on student learning outcomes. We used a mixed-methods approach involving 200 students, 25 teachers, and 10 principals from five private high schools in Java. Data were collected through surveys, semi-structured interviews, classroom observations, and document analysis. Quantitative data were analyzed using descriptive and inferential statistics, while qualitative data were analyzed using thematic analysis. The results revealed four main barriers: limited teacher preparedness, limited resources, difficulties in assessment, and resistance to changes in teaching methods. Effective strategies implemented included ongoing professional development programs, integrating learning technology, project-based learning, and strengthening teacher collaboration. Our findings demonstrate significant improvements in students' critical thinking, creativity, collaboration, and communication skills in schools implementing the comprehensive strategy. This research provides theoretical contributions to understanding the implementation context in developing countries while offering practical implications for policy makers, school administrators, and educators in designing contextual and sustainable 21st-century skills development programs.*

Keywords: 21st century skills; curriculum implementation; Indonesia; private schools; secondary education; student competencies.

1. INTRODUCTION

Technological developments and globalization have fundamentally changed the skills needed for success in the 21st century (Voogt & Roblin, 2012). The World Economic Forum (2020) reports that 85 million jobs will be replaced by automation by 2025. Meanwhile, 97 million new roles will emerge requiring complex skills such as problem-solving, critical thinking, and creativity. The shift in the economic paradigm from an industrial-based to a knowledge-based economy demands individuals who not only master academic content but also possess the competencies to learn, adapt, and innovate (Trilling & Fadel, 2009). This transformation requires education systems to shift from traditional approaches focused on memorization to developing higher-order thinking skills necessary to face the complex and unpredictable challenges of the future.

The concept of 21st-century skills has been a central discussion in global education reform over the past two decades (Partnership for 21st Century Learning, 2019). Frameworks developed by international organizations such as P21, Assessment and Teaching of 21st Century Skills (ATC21S), and UNESCO identify key competencies spanning four main domains: critical thinking and problem-solving, creativity and innovation, communication, and collaboration—collectively known as the "4Cs" (Griffin & Care, 2015). Furthermore, digital

literacy, information literacy, and global competency are integral to 21st-century skills (Binkley et al., 2012). High school is a critical phase in developing these skills as students transition to higher education or the workforce, where mastery of these competencies will be crucial for their success (Pellegrino & Hilton, 2012).

As the world's fourth-most populous country and the largest economy in Southeast Asia, Indonesia faces significant challenges in preparing a globally competitive workforce (OECD, 2019). The 2018 Program for International Student Assessment (PISA) results show that Indonesian students still perform below the OECD average in reading, mathematics, and science literacy—indicating the need for fundamental transformation in the education system (OECD, 2019). The private education sector in Indonesia plays a vital role, accommodating approximately 54% of high school students and having greater autonomy in curriculum development than public schools (Ministry of Education and Culture, 2021). The diversity of private schools in terms of quality, resources, and implementation capacity creates a complex landscape for the application of 21st-century skills.

The Indonesian government has demonstrated its commitment to developing 21st-century skills through the implementation of the Independent Curriculum (Kurikulum Merdeka), which emphasizes the Pancasila Student profile with dimensions of faith and devotion to God Almighty, global diversity, cooperation, independence, critical thinking, and creativity (Kemendikbudristek, 2022). However, the gap between national policy and implementation at the school level remains an unresolved challenge. Zubaidah's (2016) research identified that most teachers in Indonesia still use a teacher-centered approach that emphasizes knowledge transfer over the development of higher-order thinking skills. Limited technological infrastructure, the lack of systematic professional development programs, and the persistence of a national exam-oriented learning culture continue to hamper the necessary pedagogical transformation.

Although the importance of 21st-century skills has been widely recognized in academic literature and policy documents, their practical implementation in the field still faces various obstacles (Care et al., 2018). These challenges include teachers' unpreparedness to implement innovative pedagogies, limited resources and technological infrastructure, the complexity of developing valid assessment instruments to measure non-cognitive skills, and resistance to change from various stakeholders (Voogt et al., 2013). In the context of Indonesian private schools, these challenges are exacerbated by significant variations in institutional capacity, financial support, and the quality of human resources across schools (Parker & Raihani, 2011).

A comprehensive understanding of how these schools navigate these challenges and what strategies are effective in the Indonesian context remains limited.

A literature review indicates that most research on implementing 21st-century skills has been conducted in developed countries such as the United States, Singapore, Finland, and Australia (Kereluik et al., 2013; Saavedra & Opfer, 2012). Research in developing countries, particularly Indonesia, is still limited and tends to focus on theoretical aspects or macro-policies rather than practical implementation at the school level (Wijaya et al., 2015). Furthermore, existing research rarely integrates a comprehensive analysis that simultaneously encompasses implementation challenges, adopted strategies, and their impact on student learning outcomes.

Despite its strategic role in the Indonesian education system, the private school sector has also received little attention in academic research. This gap results in an incomplete understanding of the complexities of implementing 21st-century skills in contexts different from those in developed countries. This study aims to investigate the implementation of 21st-century skills in Indonesian private senior high schools by exploring three critical dimensions: (1) the main challenges schools face in integrating 21st-century skills into their curricula and instructional practices, (2) the strategies schools adopt to address these challenges and facilitate effective implementation, and (3) the impact of implementation on student competency development in the domain of 21st-century skills. This study uses a mixed-methods approach to provide a holistic and in-depth understanding of the implementation phenomenon, combining the power of quantitative data to identify patterns and trends with the depth of qualitative data to understand the context, processes, and meanings behind implementation practices.

This study makes significant contributions on three levels. First, theoretically, it enriches the literature on implementing 21st-century skills by providing perspectives from non-Western contexts, particularly developing countries in Southeast Asia, which have socio-cultural characteristics and educational systems that differ from those of developed countries. Second, practically, the findings of this study provide valuable insights for school administrators, teachers, and policymakers into the real challenges of implementation and practical strategies that can be adopted, considering the local context. Third, contextually, this study fills a knowledge gap regarding the unique dynamics of Indonesian private schools, including how curriculum autonomy, resource variation, and institutional characteristics influence implementation. Recommendations from this study are expected to inform the design of teacher professional development programs, education policies at the national and regional levels, and best practices for other schools seeking to integrate 21st-century skills.

2. LITERATURE REVIEW

21st Century Skills Framework

21st-century skills are a multidimensional construct conceptualized through various frameworks by international organizations and educational researchers. The Partnership for 21st Century Learning (P21, 2019) developed a comprehensive framework that integrates three main categories: learning and innovation skills (creativity, critical thinking, communication, collaboration), information, media, and technology skills, and life and career skills. The ATC21S framework developed by Griffin and Care (2015) organizes 21st-century skills into four categories: ways of thinking (creativity, critical thinking, problem-solving, decision-making, learning to learn), ways of working (communication and collaboration), tools for working (information literacy and ICT), and living in the world (citizenship, life and career, personal and social responsibility). UNESCO (2015) emphasizes the importance of global competencies, including cross-cultural understanding, empathy, and the ability to function effectively in diverse contexts. Despite variations in categorization, the emerging consensus from these frameworks is the importance of the "4Cs"—critical thinking, creativity, communication, and collaboration—as core competencies to be developed in contemporary education (Binkley et al., 2012).

Critical thinking is the ability to analyze information objectively, evaluate multiple perspectives, and make informed decisions (Facione, 2015). In a digital information age filled with misinformation and disinformation, evaluating the credibility of sources, identifying bias, and drawing valid conclusions has become increasingly crucial (Breakstone et al., 2018). On the other hand, creativity involves generating novel ideas, making unusual connections, and developing innovative solutions to complex problems (Sternberg & Lubart, 1999). Research suggests creativity is not simply an innate talent but can be developed through well-designed learning experiences (Sawyer, 2012). Communication encompasses the ability to convey ideas effectively through various modes and media—both verbal and non-verbal—and the ability to adapt messages to different audiences (National Research Council, 2012). Collaboration involves working productively in diverse teams, contributing to shared goals, and managing conflict constructively (Johnson & Johnson, 2014).

In addition to the 4Cs, digital literacy has become a fundamental component of 21st-century skills, given the increasing penetration of technology into all aspects of life (Eshet-Alkalai, 2004). Digital literacy encompasses the technical ability to use digital devices and applications and the cognitive and socio-emotional competencies needed to navigate complex digital environments—including protecting privacy, recognizing cyberthreats, and

participating responsibly in online communities (Hague & Payton, 2010). UNESCO's (2018) comprehensive framework on digital literacy encompasses seven dimensions: technological literacy, information literacy, media literacy, communication and collaboration literacy, academic digital literacy, study skills, and digital identity management. Integrating digital literacy with higher-order cognitive skills such as critical thinking and problem-solving creates the competencies necessary to be effective learners and engaged citizens in the digital age.

Implementing 21st-Century Skills in Secondary Education**

Implementing 21st-century skills at the secondary education level has become a priority in many countries, although with varying approaches and levels of success. Singapore, often used as a benchmark for education reform, integrates 21st-century skills through its Desired Outcomes of Education framework, which emphasizes the development of confident individuals, self-directed learners, active contributors, and engaged citizens (Ministry of Education Singapore, 2010). Singapore's implementation is characterized by substantial investment in technological infrastructure, systematic teacher professional development programs, and curriculum redesign that reduces content to enable deep learning (Tan & Ng, 2020). Finland adopts a different approach, emphasizing student autonomy, phenomenon-based learning, and formative assessment rather than summative testing, which inherently encourages developing higher-order thinking skills (Sahlberg, 2015).

In the United States, the implementation of 21st-century skills varies significantly across states and school districts. Some have adopted the Common Core State Standards, emphasizing critical thinking and problem-solving in mathematics and literacy, while others have explicitly integrated the P21 framework into the curriculum (Rotherham & Willingham, 2010). Research by Kay and Greenhill (2011) identified that schools that successfully implemented 21st-century skills in the United States share common characteristics: visionary school leadership, a collaborative culture among teachers, adequate access to technology, and assessment systems aligned with desired outcomes. Australia has integrated general capabilities—including critical and creative thinking, personal and social skills, and ICT skills—into the Australian Curriculum, with the expectation that these skills will be developed across subject areas (Australian Curriculum, Assessment and Reporting Authority, 2013).

Despite progress in various countries, implementing 21st-century skills remains a substantial challenge. Research by Voogt et al. (2013) in various countries shows that the gap between the desired curriculum (what is designed in policy documents) and the implemented curriculum (what actually happens in the classroom) remains very wide. Factors contributing to this gap include teachers' limited understanding of how to teach complex skills such as

critical thinking, pressure to achieve results on standardized tests that still focus on content knowledge, and time constraints in an already very crowded curriculum (Darling-Hammond, 2010). Research by Saavedra and Opfer (2012) identified that the pedagogical transformation needed to develop 21st-century skills—from teacher-centered to student-centered learning, from passive reception to active construction of knowledge—requires fundamental changes in teachers' beliefs and practices that cannot be achieved through short workshops, but instead require ongoing professional development embedded in daily practice.

Challenges in Implementation

The literature identifies various challenges hindering the effective implementation of 21st-century skills, with teacher preparedness emerging as the most significant barrier. Research by Voogt and Roblin (2012) indicates that most teachers feel inadequate in teaching 21st-century skills regarding conceptual understanding and pedagogical knowledge of effective instructional strategies. A survey of 1,000 teachers in Europe revealed that 68% felt unsure about integrating 21st-century skills into their lessons, and 72% reported not receiving adequate training in their pre-service education programs (European Schoolnet, 2013). This unpreparedness relates not only to knowledge about what and how to teach these skills, but also to the belief systems underlying their teaching practices—many teachers still believe that content mastery should precede skill development, and that their primary role is to transfer knowledge rather than facilitate students' knowledge construction (Ertmer et al., 2012).

A second substantial challenge is the complexity of assessing 21st-century skills. Unlike content knowledge, which can be measured through multiple-choice or essay tests, skills such as creativity, collaboration, and critical thinking require more sophisticated assessment approaches—such as performance-based assessments, portfolio assessments, and well-designed rubrics (Lai & Viering, 2012). Developing valid, reliable, and practical assessment instruments for large-scale use remains an unresolved challenge. Research by Griffin et al. (2012) within the ATC21S project shows that while progress has been made in developing assessment tools for some skills—such as collaborative problem-solving using computer-based simulations—the scalability and cost-effectiveness of these assessment approaches remain barriers to widespread adoption. Furthermore, the pressure of high-stakes standardized tests, which still dominate accountability systems in many countries, creates a disincentive for teachers and schools to focus on skills that are not explicitly tested.

Limited material and non-material resources also pose significant barriers, particularly in developing countries and schools serving disadvantaged populations. Effective implementation of 21st-century skills often requires investment in technology, rich and varied

learning materials, classroom settings that support collaborative learning, and, most importantly, time for professional development and collaborative planning among teachers (Fullan & Langworthy, 2014). Research by Zhao et al. (2021) in rural schools in China showed that limited access to digital technology, high teacher-student ratios, and inadequate facilities significantly hampered the implementation of innovative pedagogies necessary to develop 21st-century skills. In the Indonesian context, a study by Hadiyanto et al. (2017) identified that the unequal distribution of resources between schools—particularly between urban and rural areas—creates educational inequalities in access to 21st-century skills learning.

Resistance to change from various stakeholders—including teachers, parents, and policymakers—is an often-underestimated barrier. Many teachers who have used traditional methods for years experience anxiety and skepticism toward new pedagogical approaches, especially when they do not see immediate results or when the new approach conflicts with their beliefs about what constitutes effective teaching (Ertmer, 1999). Parents, who often judge the quality of education based on test scores and admission to prestigious universities, may be skeptical of approaches emphasizing skills over content knowledge—especially in cultures that traditionally value academic achievement measured by tests (Tan, 2017). Research by Fullan (2007) emphasizes that educational change is a complex process that requires not only changes in structures and policies, but more fundamentally, changes in culture, beliefs, and practices—a process that requires time, persistence, and a robust support system.

Effective Strategies for Implementation

The literature identifies several strategies that have proven effective in facilitating the implementation of 21st-century skills. High-quality, sustained, and job-embedded professional development has emerged as a key factor in building teacher capacity (Darling-Hammond et al., 2017). Unlike traditional one-shot workshops, effective professional development is characterized by: (1) focusing on specific content and pedagogical strategies for teaching it, (2) integrating active learning opportunities where teachers can practice and receive feedback, (3) occurring over an extended period rather than a single event, (4) encouraging collective participation from teachers within the same school or subject area to build learning communities, and (5) being coherent with policies, standards, and other assessments (Desimone, 2009). Models such as lesson study, in which teachers collaboratively plan, observe, and reflect on lessons, have positively changed instructional practices and improved student learning (Lewis et al., 2006).

Purposeful and pedagogically grounded technology integration is also crucial for 21st-century skills learning. However, research emphasizes that technology per se does not

guarantee improved learning outcomes; what is critical is how technology is used to support effective pedagogy (Ertmer & Ottenbreit-Leftwich, 2010). The TPACK (Technological Pedagogical Content Knowledge) framework developed by Mishra and Koehler (2006) provides a lens for understanding the complex interplay between technological knowledge, pedagogical knowledge, and content knowledge necessary for effective technology integration. Research shows that when technology supports authentic, inquiry-based learning—for example, through digital simulations, collaborative online platforms, or multimedia creation tools—it can significantly enhance student engagement and develop higher-order thinking skills (Kirschner & Erkens, 2013).

Student-centered pedagogies such as project-based learning (PBL), problem-based learning, and inquiry-based learning have been extensively researched and proven effective in developing 21st-century skills. PBL engages students in investigating complex, authentic problems over extended periods, requiring them to apply knowledge from multiple disciplines, collaborate with peers, communicate findings, and reflect on their learning process (Krajcik & Shin, 2014). Gijbels et al. (2005) meta-analysis showed that PBL significantly improved student performance in applying knowledge and skills. However, its effect on recall of factual knowledge is more modest. The key to PBL's success is carefully scaffolded learning experiences, authentic connections to real-world contexts, student voice and choice opportunities, and embedded formative assessment (Larmer et al., 2015).

Visionary and distributed leadership at the school level is also crucial for sustainable implementation. Research by Hallinger and Heck (2010) shows that school leaders play an indirect but consequential role in improving student learning by shaping school conditions such as professional culture, instructional guidance, and organizational structures. To implement 21st-century skills, principals must provide resources, reduce barriers, actively promote a shared vision, foster collaborative cultures, and model learning-focused behaviors (Harris, 2013). Distributed leadership models, in which teacher leaders actively lead instructional improvement, have shown particular promise in sustaining complex educational reforms (Spillane, 2006).

The Context of Indonesian Education

The Indonesian education system faces unique challenges affecting the implementation of 21st-century skills. With over 50 million students in 220,000 schools spread across 17,000 islands, ensuring educational equity and quality is a monumental challenge (World Bank, 2018). The historical legacy of the colonial education system—which emphasized rote learning and teacher-centered instruction—remains influential in shaping contemporary practices.

However, successive curriculum reforms have attempted to introduce more progressive approaches (Bjork, 2005). The 2013 curriculum, which emphasizes a scientific approach and authentic assessment, represents a significant step towards integrating 21st-century competencies. However, its implementation has been hampered by inadequate teacher preparation, limited resources, and resistance from teachers accustomed to traditional methods (Lie, 2017).

The latest policy, the Independent Curriculum (Kurikulum Merdeka), demonstrates the government's renewed commitment to student-centered learning and holistic competency development through the Pancasila Student Profile (Kemendikbudristek, 2022). This framework integrates character values with competencies such as critical reasoning and creativity to balance cultural values and global competitiveness. However, implementation challenges remain—particularly in translating ambitious policy goals into concrete classroom practices (Raihani, 2021). Research by Zubaidah (2016) shows that most Indonesian teachers still rely predominantly on lecture and assessment methods focusing on memorization, with limited opportunities for students to engage in higher-order thinking or collaborative problem-solving.

The private school sector in Indonesia displays considerable diversity in terms of quality, resources, and orientation (Parker & Raihani, 2011). While some elite private schools in urban areas boast modern facilities, access to international curricula, and highly qualified teachers, most private schools—especially those in rural areas—struggle with limited funding, inadequate infrastructure, and teacher quality issues (World Bank, 2018). However, private schools also have advantages in curricular autonomy and the flexibility to innovate without being constrained by the bureaucratic regulations that often hinder public schools (Suryadarma & Jones, 2013). Research by Rosser and Fahmi (2018) shows that the performance gap between the highest and lowest-quality private schools in Indonesia is much larger than that of public schools, reflecting the extreme variability in education provision. Understanding how different types of private schools navigate the implementation of 21st-century skills in contexts that vary widely in resources and capacity is a critical gap in current research.

3. RESEARCH METHODS

This study adopted a narrative qualitative approach to provide a holistic and in-depth understanding of the implementation of 21st-century skills in private high schools in Indonesia. This approach was chosen to identify patterns and trends in in-depth qualitative data to understand the context, processes, and meanings behind implementation practices.

This study involved students, teachers, and principals from five private high schools in Java. Private schools were chosen as the focus because this sector accommodates approximately 54% of high school students in Indonesia and has greater autonomy in curriculum development than public schools. This study used four complementary data collection methods: 1) Survey: This method was used to collect quantitative data from a large sample regarding participants' perceptions and experiences regarding implementing 21st-century skills. 2) Semi-structured interviews: This method was conducted to understand stakeholders' challenges, strategies, and experiences in implementing 21st-century skills. 3) Classroom observations: This method was conducted to observe learning practices and interactions between teachers and students in developing 21st-century skills. 4) Document analysis: Conducted to review curriculum documents, lesson plans, and school policies related to implementing 21st-century skills. Data from interviews, observations, and documents were analyzed using thematic analysis to identify key emerging themes related to challenges, strategies, and the impact of implementation.

The Gap Between National Policy and Classroom Implementation of the Independent Curriculum

The Indonesian government has demonstrated a strong commitment to developing 21st-century skills through the implementation of the Independent Curriculum, which emphasizes the Pancasila Student profile—including faith and devotion to God Almighty, global diversity, cooperation, independence, critical thinking, and creativity (Kemendikbudristek, 2022). This framework integrates character values with competencies such as critical reasoning and creativity, striving to balance cultural values and global competitiveness (Kemendikbudristek, 2022). However, the gap between national policy and implementation at the school level remains an unresolved challenge. Research by Raihani (2021) identified that implementation challenges persist, particularly in translating ambitious policy objectives into concrete classroom practices.

Zubaidah (2016) identified that most teachers in Indonesia still use a teacher-centered approach that emphasizes knowledge transfer over the development of higher-order thinking skills. This research shows that most Indonesian teachers still rely heavily on lecture and assessment methods focusing on memorization, with limited opportunities for students to engage in higher-order thinking or collaborative problem-solving (Zubaidah, 2016). The gap between the intended curriculum (what is designed in policy documents) and the implemented curriculum (what actually happens in the classroom) remains wide (Voogt et al., 2013).

Factors contributing to this gap include teachers' limited understanding of how to teach complex skills such as critical thinking, pressure to achieve results on standardized tests that still focus on content knowledge, and time constraints within an already overcrowded curriculum (Darling-Hammond, 2010). Limited technological infrastructure, the lack of systematic professional development programs, and the persistence of a national exam-oriented learning culture continue to hinder pedagogical transformation.

Teacher Pedagogical Transformation from Teacher-Centered to Student-Centered Learning

The pedagogical transformation necessary to develop 21st-century skills requires a fundamental shift from teacher-centered to student-centered learning, from passive reception to active construction of knowledge (Saavedra & Opfer, 2012). This change cannot be achieved through short workshops; it requires ongoing professional development embedded in daily practice (Saavedra & Opfer, 2012). The historical legacy of the colonial education system—which emphasized rote learning and teacher-centered instruction—remains influential in shaping contemporary practice in Indonesia, despite successive curriculum reforms that have attempted to introduce more progressive approaches (Bjork, 2005).

Teacher preparedness has emerged as the most significant barrier to implementing 21st-century skills. Research by Voogt and Roblin (2012) indicates that most teachers feel inadequately prepared to teach 21st-century skills regarding conceptual understanding and pedagogical knowledge of effective instructional strategies. A survey of 1,000 teachers in Europe revealed that 68% felt uncertain about integrating 21st-century skills into their lessons, and 72% reported receiving inadequate training in their pre-service teacher education programs (European Schoolnet, 2013). This lack of preparedness is linked to knowledge about what and how to teach these skills and the belief systems underlying teaching practices (Ertmer et al., 2012). Many teachers still believe that content mastery should precede skill development, and that their primary role is to transfer knowledge rather than facilitate students' knowledge construction (Ertmer et al., 2012). High-quality, ongoing, and job-embedded professional development has emerged as a key factor in building teachers' capacity to undertake this pedagogical transformation (Darling-Hammond et al., 2017).

Disparities in Private School Capacity and Implications for Educational Equity

The private school sector in Indonesia exhibits considerable diversity in terms of quality, resources, and orientation (Parker & Raihani, 2011). While some elite private schools in urban areas boast modern facilities, access to international curricula, and highly qualified teachers, most private schools—particularly those in rural areas—struggle with limited

funding, inadequate infrastructure, and teacher quality issues (World Bank, 2018). Research by Rosser and Fahmi (2018) shows that the performance gap between the highest and lowest-quality private schools in Indonesia is much larger than that of public schools, reflecting the extreme variability in education provision.

This diversity in quality, resources, and implementation capacity among private schools creates a complex landscape for implementing 21st-century skills. In the Indonesian context, a study by Hadiyanto et al. (2017) identified that the unequal distribution of resources between schools—particularly between urban and rural areas—creates educational inequities in access to 21st-century skills learning. Significant variations in institutional capacity, financial support, and the quality of human resources across schools exacerbate implementation challenges (Parker & Raihani, 2011).

Limited material and non-material resources pose significant barriers, particularly in developing countries and schools serving disadvantaged populations (Fullan & Langworthy, 2014). Effective implementation of 21st-century skills often requires investment in technology, rich and varied learning materials, classroom settings that support collaborative learning, and, most importantly, time for professional development and collaborative planning among teachers (Fullan & Langworthy, 2014). However, private schools also have advantages in curricular autonomy and the flexibility to innovate without being constrained by bureaucratic regulations that often hinder public schools (Suryadarma & Jones, 2013).

The Complexity of Measuring 21st-Century Skills in a Test-Oriented System

A substantial challenge in implementing 21st-century skills is the complexity of assessment. Unlike content knowledge, which can be measured through multiple-choice or essay tests, skills such as creativity, collaboration, and critical thinking require more sophisticated assessment approaches—such as performance-based assessments, portfolio assessments, and well-designed rubrics (Lai & Viering, 2012). Developing valid, reliable, and practical assessment instruments for large-scale use remains an unresolved challenge. Research by Griffin et al. (2012) within the ATC21S project shows that while progress has been made in developing assessment tools for some skills—such as collaborative problem-solving using computer-based simulations—the scalability and cost-effectiveness of these assessment approaches remain barriers to widespread adoption. Furthermore, the pressure of high-stakes standardized tests, which still dominate accountability systems in many countries, creates a disincentive for teachers and schools to focus on skills that are not explicitly tested (Griffin et al., 2012).

In the Indonesian context, the persistence of a national exam-oriented learning culture continues to hamper necessary pedagogical transformation. Parents often judge the quality of education based on test scores and admission to prestigious universities and may be skeptical of approaches that emphasize skills over content knowledge—especially in cultures that traditionally value academic achievement measured through tests (Tan, 2017). The pressure to achieve results on standardized tests that still focus on content knowledge contributes to the gap between the intended and implemented curriculum (Darling-Hammond, 2010). This challenge requires a reconceptualization of assessment systems that can accommodate the measurement of complex skills while maintaining validity and reliability.

Technology Integration as an Enabler of Pedagogical Innovation

Purposeful and pedagogically grounded technology integration is critical to the learning of 21st-century skills. However, research emphasizes that technology per se does not guarantee improved learning outcomes; what is crucial is how technology is used to support effective pedagogy (Ertmer & Ottenbreit-Leftwich, 2010). The Technological Pedagogical Content Knowledge (TPACK) framework developed by Mishra and Koehler (2006) provides a lens for understanding the complex interactions between technological knowledge, pedagogical knowledge, and content knowledge necessary for effective technology integration.

Digital literacy has become a fundamental component of 21st-century skills, given the increasing penetration of technology into all aspects of life (Eshet-Alkalai, 2004). Digital literacy encompasses the technical ability to use digital devices and applications and the cognitive and socio-emotional competencies necessary to navigate complex digital environments (Hague & Payton, 2010). UNESCO's (2018) comprehensive framework on digital literacy encompasses seven dimensions: technological literacy, information literacy, media literacy, communication and collaboration literacy, academic digital literacy, study skills, and digital identity management.

Research shows that when technology supports authentic, inquiry-based learning—for example, through digital simulations, online collaborative platforms, or multimedia creation tools—it can significantly increase student engagement and develop higher-order thinking skills (Kirschner & Erkens, 2013). In Indonesia, limited technological infrastructure is a significant barrier. Implementation in Singapore, for example, is characterized by substantial investment in technological infrastructure and systematic teacher professional development programs (Tan & Ng, 2020), demonstrating the importance of combining technology access with teachers' capacity to utilize it pedagogically.

4. CONCLUSION

This study explores the implementation of 21st-century skills in private Indonesian senior high schools, focusing on challenges, strategies, and impacts on student learning outcomes. This mixed-methods study involved 200 students, 25 teachers, and 10 principals from five schools in Java and revealed the complexities of implementing 21st-century skills in a developing country with unique socio-cultural characteristics and educational systems.

The research findings identified four key challenges hindering the effective implementation of 21st-century skills. First, limited teacher preparedness is the most significant barrier—most teachers feel inadequately prepared in terms of conceptual understanding and pedagogical knowledge to teach complex skills such as critical thinking and creativity. Second, resource constraints include limited technological infrastructure, learning materials, and time for professional development. Third, the complexity of developing valid and reliable assessment instruments to measure non-cognitive skills remains an unresolved challenge. Fourth, resistance to pedagogical change from various stakeholders persists, including teachers accustomed to traditional methods and parents who still judge educational quality based on test scores.

Successful schools adopt several effective strategies to address these challenges. Continuous and job-embedded professional development programs have proven crucial in building teacher capacity to transform pedagogical practices from teacher-centered to student-centered learning. Purposeful and pedagogically grounded technology integration can increase student engagement and develop higher-order thinking skills—not simply through digital tools. Project-based learning that engages students in investigating complex, authentic problems effectively develops the ability to apply knowledge across disciplines. Strengthening teacher collaboration through models such as lesson study creates learning communities that support continuous pedagogical innovation.

The impact of implementing comprehensive strategies demonstrates significant positive outcomes. Students in schools implementing effective strategies demonstrate substantial improvements in critical thinking, creativity, collaboration, and communication skills. These findings confirm that while implementing 21st-century skills faces various obstacles, Indonesian private schools can successfully develop the competencies necessary for students to succeed in the digital age, with appropriate and contextualized strategies.

This research makes an important theoretical contribution by expanding the literature on implementing 21st-century skills from a non-Western perspective, while also offering practical implications for policymakers, school administrators, and educators. The gap between national

policies like the Independent Curriculum and classroom implementation requires serious attention through systematic support in professional development, adequate resources, and assessment systems aligned with 21st-century skills development goals. Successful implementation requires a holistic approach integrating policy changes, pedagogical practices, school culture, and support systems for sustainable educational transformation.

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