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ANALYSIS OF THE READINESS FOR EDUCATION 4.0 TRANSFORMATION IN INDONESIA AND TÜRKIYE

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ABSTRACT

This article examines the readiness of Education 4.0 transformation in Indonesia and Türkiye through a comparative qualitative literature review. Education 4.0 emphasizes the integration of digital technology, innovative pedagogy, and the development of 21st-century skills in response to the challenges of the Industrial Revolution 4.0. Employing a descriptive qualitative approach with library research methods, this study analyzes national and international literature published between 2020 and 2025 to identify patterns of curriculum policy, technology integration, and teacher readiness in both countries. The findings indicate that Indonesia and Türkiye share common structural challenges, particularly related to unequal access to technological infrastructure and varying levels of teacher readiness across regions. At the same time, differences emerge in policy orientation and implementation strategies, where Indonesia places greater emphasis on curricular flexibility and pedagogical reform through the Merdeka Curriculum, while Türkiye prioritizes large-scale national technology initiatives, such as the Turkish Century Education Model, the FATIH Project, and the Education Information Network (EBA), to support digital learning. The study concludes that both countries remain in a transitional phase toward Education 4.0, and that a more integrated alignment between curriculum reform, teacher capacity development, and technology provision is essential to strengthen sustainable pedagogical transformation in developing country contexts.

Keywords : *Education 4.0, Readiness, Curriculum, Teacher, Implementation, Digital transformation, 21st-century skills*

INTRODUCTION

The development of the Industrial Revolution 4.0 has prompted fundamental changes in the needs of individual competencies, so that the education system is required to adapt to the dynamics of technology, automation, and digitalization. In this context, 21st century learning focuses on students with the necessary special skills of critical thinking, problem-solving, metacognition, communication, collaboration, innovation and creativity, and information literacy (Mardhiyah et al., 2021). Education is no longer solely oriented to the mastery of knowledge, but to the ability of students to adapt and innovate in a complex and constantly changing environment.

In response to these demands, the concept of Education 4.0 is developing as an educational transformation framework that emphasizes the integration of digital technology, pedagogical innovation, and strengthening 21st century skills in the learning system. Education 4.0 is understood not only as the use of technology in the learning process, but as a systemic transformation that includes curriculum approaches, learning strategies, and the development of students' competencies to be relevant to future needs (Pérez & Montoya, 2022). The learning

process no longer focuses only on mastery of the material, but emphasizes more on the ability of students to search, process, and apply knowledge in daily life, by utilizing technology to solve problems (Iskandar et al., 2025).

Education 4.0 is supported, facilitated, and directed by technology. In contrast to the traditional methods that we usually used in the past, Love (2020) argues that this new learning system allows students to develop with lifelong knowledge and skills, not only to be able to read and write, but also to be able to live in society and be equipped with the best of their abilities.

In the Indonesian context, various educational reform efforts have been carried out to respond to the demands of this transformation, one of which is through the implementation of the Kurikulum Merdeka which normatively emphasizes learning flexibility and strengthening student competencies. The implementation of this policy requires the readiness of educators to adapt to new learning plans and teaching methods, but studies show that teachers' readiness still needs to be improved to face this paradigmatic change (Gurion, 2024). However, the implementation of Education 4.0 in Indonesia still faces a number of obstacles, such as limited digital literacy of teachers, variations in access to technology, and school readiness that differs greatly between regions, which hinder the equitable distribution of skills-based learning practices in the 21st century (Aulia et al., 2025). This condition shows that the readiness for Education 4.0 transformation in Indonesia is still in the transition stage and is not completely evenly distributed.

Beyond the Indonesian context, Türkiye offers a relevant comparative case . Türkiye is a relevant comparative context because the country is carrying out curriculum and education policy reforms that are oriented towards technology integration and strengthening Education 4.0 competencies. Recent studies show that Türkiye 's national curriculum has begun to represent Education 4.0 competencies more systematically, particularly in 21st century skills development and digital literacy, although implementation challenges at the school level remain (H. Yılmaz & Tunçel, 2025). This condition makes Türkiye a potential learning case in seeing the practice of Education 4.0 transformation in developing countries.

The selection of Turkiye as a comparative country is based on the fact that the country does not represent the context of best practices of developed countries, but rather a transitional context that faces similar challenges to Indonesia, such as equal access to technology, teacher readiness, and capacity of educational institutions. This allows for comparative analysis that is not normative, but problematic and reflective of the reality of the implementation of Education 4.0 in developing countries.

Although studies on Education 4.0 and 21st century skills have evolved in the past five years, most research still focuses on a single national context or is limited to descriptions of learning policies and practices. Studies that explicitly compare the readiness of Education 4.0 implementation between countries, especially using 21st century skills as an indicator of readiness, are still relatively limited. Therefore, there is a need to conduct a comparative analysis that is able to describe the differences in the level of readiness and obstacles to educational transformation more comprehensively.

Based on this background, this article aims to analyze the readiness of education in Indonesia and Türkiye in implementing Education 4.0. Through a descriptive qualitative approach, this article is expected to identify relevant readiness, challenges, and strategic learning for strengthening the transformation of Education 4.0 in Indonesia based on Türkiye 's experience.

METHODS

The research approach used in this article is qualitative descriptive with the library research method. This method aims to describe and understand in depth the phenomenon studied through a systematic review of various relevant literature sources (Ardiansyah et al., 2025). This approach aims to deeply understand the concepts, strategies, and practices of implementing the transformation of Education 4.0 in Indonesia and Türkiye through a critical examination of various sources of scientific literature.

According to Achmad (2025) and Nawawi (1995) stated that literature research is a theoretical data collection process by examining various sources such as books, scientific journals, articles, and other relevant documents.

Literature data sources are obtained in the form of national and international journal articles, as well as the results of previous research relevant to the study topic. Data collection was carried out through literature search on online databases such as Google Scholar with the help of Publish or Perish and considered the relevance of the topic and the up-to-date publication (2020-2025).

The data obtained were analyzed using content analysis techniques and thematic analysis by identifying, grouping, and interpreting the main themes that appeared in the literature. The results of the analysis were then synthesized descriptively to formulate implementation patterns, challenges, and implications of 21st century skills development in the transformation of Education 4.0 in both contexts of the country studied.

RESULT AND DISCUSSION

Implementation of Education 4.0 in Indonesia

In an effort to adapt the education system to the demands of the 21st century, the transformation of Education 4.0 in Indonesia is realized through policies that emphasize learning flexibility and strengthening student competencies. The implementation of the Kurikulum Merdeka represents the government's efforts to shift the educational paradigm from a content-based approach to 21st century skill development. Empirical study conducted by Amrullah (2024) clarified that the Kurikulum Merdeka plays an important role in supporting educational transformation in the era of the Industrial Revolution 4.0 through an emphasis on developing student competencies. This curriculum encourages learning that is more relevant to students' interests and potentials and contributes to improving learning outcomes and readiness to face social and technological dynamics. The Merdeka Curriculum emphasizes the development of metacognitive skills—including self-understanding, monitoring, and regulating the learning process—as the foundation for shaping independent learners who are able to effectively develop 21st-century skills (Widiansyah et al., 2024).

Based on its implementation, the Kurikulum Merdeka faces several obstacles. Empirical studies show that there are at least several obstacles: facilities, teaching staff, student background, and the government (Nisa et al., 2023). The main challenges are still related to the limitations of educators' digital literacy, inequality of access and use of technology between regions, and variations in school capacity in implementing policies into learning practices. Limited facilities are one of the main obstacles in the implementation of the Kurikulum Merdeka, especially at the elementary school level. The lack of learning support facilities, such as classrooms, libraries, laboratories, and technology facilities, causes the implementation of this curriculum to not run optimally. In addition, project-based learning that characterizes the Kurikulum Merdeka requires adequate budget support, while limited costs for the provision of teaching materials and teaching aids are still an obstacle in a number of schools (Adi, 2025).

In addition to limited facilities and funding support, teacher quality is a crucial factor that affects the effectiveness of the implementation of the Kurikulum Merdeka. Changes in the learning paradigm that emphasize differentiation, project-based learning, and technology integration require pedagogic and professional competencies of teachers who are adaptive to the demands of Education 4.0. Based on the findings of the literature, the practice of teacher readiness shows that the learning process runs smoothly and coordinated, characterized by the ability of teachers to manage time and resources effectively and utilize physical and digital

learning media, such as books and videos, reflecting the improvement of teachers' competence in integrating information technology (Sephiawardani & Bektiningsih, 2023).

Rizqi (2025) emphasized that teachers in urban areas are generally better prepared because they have better access to technology facilities than teachers in areas with limited access to the internet and digital devices. This shows that the readiness of teachers is not individual, the government needs to review the equitable distribution of technology in each region so that there is no inequality due to location limitations.

Based on some of the literature findings that have been described, a pattern of readiness for Education 4.0 transformation in Indonesia was found, namely: curriculum policy, technology integration, and teacher readiness. The three patterns are summarized in the following table:

Table 1. Pattern of Education Transformation Readiness 4.0 in Indonesia

Education Readiness 4.0	Implementation Results
Curriculum Policy	Kurikulum Merdeka: relevant learning according to students' interests and potential in readiness to face social and technological dynamics (Amrullah et al., 2024).
Technology Integration	It has barriers to technological devices and internet access (Adi, 2025).
Teacher Readiness	There is an imbalance in preparation caused by unequal access to facilities and infrastructure in each region (Rizqi et al., 2025).

The four patterns above indicate that the readiness of Education 4.0 in Indonesia is still in the transition phase, where policy changes have been progressive, but their implementation has not taken place evenly and consistently.

Implementation of Education 4.0 in Türkiye

Türkiye 's education transformation towards Education 4.0 is driven by a relatively coherent national policy framework that emphasizes digitalization, innovation, and institutional capacity building. Previous studies have shown that Türkiye has integrated digital competencies into its education agenda through centralized policy initiatives and structured implementation strategies (Himmetoglu et al., 2020). This policy coherence provides a supportive environment for schools to adapt to technological changes more effectively.

Recent national policy reforms such as the Turkish Century Education Model curriculum show the direction of integrating 21st century skills and digital literacy in the

primary and secondary education curriculum in Türkiye (Gürhan, 2025). Several empirical studies show the early impact of the Turkish Century Education Model on the quality of education. The evaluation of the 1st grade Turkish curriculum within this model framework indicates the improvement of students' language and social skills as well as the teacher's positive perception of a more student-centered and contextual approach to learning (Aybek & Oğuz, 2025). Another study on the elementary math curriculum found that the new curriculum prioritizes the development of critical thinking, problem-solving, and creativity, which are at the core of 21st-century learning (KILIÇ, 2025). In addition, an analysis of curriculum components shows that many learning outcomes are related to 21st century skills—such as critical thinking, problem solving, and self-management—although the integration of digital literacy still needs to be expanded (Yereyıkılmaz, 2025). These findings show that these reforms are not only normative but are beginning to show real indicators of improving the quality of education in Turkish schools.

Recent research shows that digital technology has been increasingly integrated into pedagogical practices and learning strategies in Turkish schools, including efforts to improve teachers' digital competence and the use of digital platforms and tools in daily teaching, despite challenges related to teachers' ability to produce digital content and the deeper use of technology in learning activities (Alptekin & Taneri, 2025).

Yılmaz (2023) argues that technological integration in Türkiye is developed through structured and systematic national initiatives, in particular through the implementation of *FATİH Project* at the primary and secondary education levels. *The FATIH Project (Fırsatları Artırma ve Teknolojiyi İyileştirme Hareketi)* is a national program that prioritizes five areas: (1) Providing hardware and software infrastructures, (2) Providing and managing educational e-content, (3) Using efficient IT in curricula, (4) In-service training of teachers, and (5) Ensuring conscious, secure, manageable, and measurable use of IT (Cengiz, 2020). The program focuses on providing a relatively equitable digital infrastructure, including high-speed internet access in schools, the use of interactive whiteboards in classrooms, and the use of national digital platforms *Education Information Network* (EBA) for teachers and students. EBA functions as an online learning ecosystem that provides digital content, e-learning modules, and training facilities for educators.

The integration of technology in Türkiye still experiences obstacles in equity, as a result of which teachers who do not have adequate technological facilities still apply conventional models (Tut et al., 2021). Roots (2025) emphasized that another cause of inequality is from the student's family background.

Based on the above explanation, a similar pattern of transformation of Education 4.0 readiness in Türkiye and Indonesia is found in the following table:

Table 2. Patterns of Education Transformation Readiness 4.0 in Türkiye

Education Readiness 4.0	Implementation Results
Curriculum Policy	Turkish Century Education: the integration of 21st century skills and digital literacy in the curriculum of primary and secondary education in Türkiye (Gürhan, 2025).
Technology Integration	FATIH Project and EBI, access to technology has not been evenly distributed (I. Yılmaz et al., 2023).
Teacher Readiness	There is an imbalance in preparation caused by unequal access to facilities and infrastructure in each region (Tut et al., 2021).

The four patterns above suggest that the readiness of Education 4.0 in Türkiye is still in a transition phase, the country's curriculum policy is relevant to 21st century skills, and has technological facilities/programs that are very helpful for teachers in teaching. Even so, the readiness of teachers is still dependent on the equitable distribution of technology access.

Similarities and Differences of Education 4.0 in Indonesia and Türkiye

Based on the presentation of the implementation of Education 4.0 in the previous countries, the two countries have a similar pattern. The similarities are compared in the table below:

Table 3. Similirarities of Education 4.0 Indonesia and Türkiye

Implementation	Indonesia	Tukey
Curriculum Policy	Kurikulum Merdeka: National policies designed to respond to the demands of Education 4.0	Turkish Century Education: National policies designed to respond to the demands of Education 4.0
Technology integration	Technology is positioned as an important part of supporting the learning process.	Technology is positioned as an important part of supporting the learning process.
Teacher readiness	Teachers are required to adapt to digital-based	Teachers are required to adapt to digital-based

	learning and 21st-century competencies.	learning and 21st-century competencies.

The table above shows that both countries share the same need for Education 4.0 reforms related to 21st-century skills. However, the two countries differ in their views on the main functions of these various components. These differences are summarized in the table below.

Table 4. Difference of Education 4.0 Indonesia and Türkiye

Implementation	Indonesia	Tukey
Curriculum Policy	Curriculum reform that emphasizes flexibility and student-centered learning	A national program focused on the transformation of educational technology
Technology integration	Technology serves as a tool to support pedagogical approaches.	Technology is a key component in learning systems.
Teacher readiness	Emphasis on teachers' pedagogical, reflective, and metacognitive readiness	Emphasis on technical readiness and ability to integrate technology

The results of the comparison show that both Indonesia and Turkiye still face relatively similar obstacles in terms of equitable access to educational technology, especially related to infrastructure inequality and technology utilization between regions. These findings indicate that the challenge of equity is a structural issue that is commonly faced by developing countries in the transition to Education 4.0. However, a striking difference can be seen in the aspects of the curriculum and the supporting policy framework. Türkiye shows a more mature level of readiness through the strengthening of a curriculum that is explicitly integrated with 21st-century skills as well as the support of national technology programs such as the FATİH Project and the Education Information Network (EBA). The existence of these programs allows for a more systematic integration of technology from policy level to learning practice, although the challenge of equal access is still not fully resolved.

The similarity of obstacles between the two countries shows that the problem of equitable access to technology is not solely due to the weakness of certain national policies, but is a structural challenge in the implementation of Education 4.0 in developing countries. The difference in curriculum readiness and technology program support in Turkiye provides contextual learning for Indonesia, especially in terms of how national policies and programs can accelerate the integration of 21st-century skills despite facing similar access limitations.

CONCLUSION

This study concludes that the readiness for Education 4.0 transformation in Indonesia and Türkiye shows similarities and differences in aspects of curriculum policy, technology integration, and teacher readiness. In both countries, curriculum reforms are increasingly emphasizing 21st-century skills development and student-centered learning, reflecting a shared commitment to responding to the demands of digital transformation. However, the implementation of the reform still faces structural obstacles, especially inequality in the distribution of infrastructure and access to technology between regions, which have an impact on the uneven distribution of learning practices and teacher readiness.

The results of the comparison also show that Türkiye has a relatively stronger level of readiness in linking curriculum reform to national technology programs. Initiatives such as Türkiye 's 21st Century Education Model, the FATİH Project, and the Education Information Network (EBA) provide a more integrated framework to support the use of technology in the learning process.

Based on several literature studies, the implementation of Education 4.0 can be improved in various ways, such as Curriculum must also pay attention to the role of teachers as learning facilitators who are able to accommodate students' individual needs in order to reach their maximum potential (Darmawati & Pulunga, 2025), student engagement facilitated by effective learning and use of technology (Bohari et al., 2025), and Skill development in achieving a high level of knowledge and developing basic qualities for personal and professional development (Akimov et al., 2023).

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