



Educational Technology Innovation in Transformation Education Era 5.0

Akdel Parhusip^{1,*}, Mariati Purnama Sitanggang²

¹Institut Agama Kristen Renatus (IAKR) Pematang Siantar, Indonesia

²Sekolah Tinggi Teologi Amsal Medan, Medan, Indonesia

*renatusparnasipabdi@yahoo.co.id

Abstract. The ongoing revolution is driving human civilization to evolve, consistently following an increasingly advanced trajectory. At present, this revolution is progressing into the Transformation 5.0 era. The previous 4.0 era addressed concerns about the diminishing role of humans across various sectors. This transformation is evident in several fields, including education. Education is evolving in line with the 5.0 revolution, which combines innovations from the 4.0 era while positioning human resources at the centre of control. This literature review aims to explore the transformation 5.0 in education, highlighting the opportunities and challenges individuals face within the sector. Findings from multiple studies indicate that education is currently embracing various technological advancements to enhance the learning experience. These include integrating artificial intelligence, the Internet of Things, and Big Data into educational practices. Furthermore, the emphasis in the 5.0 era of education is placed on technological progress, literacy skills, character development, and the enhancement of both competencies and soft skills.

Keywords: Educational, Education era 5.0, Technology.

1 Introduction

Human innovation drives the technological advancement of the Industrial Revolution [1]. Since the mid-19th century, significant transformations have taken place within the industrial sector. This phenomenon is characterized by the shift from manual labor to machine-powered operations, providing greater convenience [2]. Over time, the revolution has progressed through multiple phases, from 1.0 to 4.0, each with distinct features [1]. During the Socialization of the Industry 4.0 Implementation Roadmap, Airlangga Hartarto highlighted that Indonesia entered the Industrial 4.0 era in 2011. Enhanced connectivity, interaction, and integration between humans, machines, and other resources marked this phase [3]. Such advancements facilitate the rapid exchange of data and information through internet-based technologies. The impact of this revolution extends beyond industry, influencing various sectors, including education [4]. The Industrial Revolution is a period of rapid change, where technology simplifies and accelerates work processes.

© The Author(s) 2025

K. Wijaya et al. (eds.), *Proceedings of the 6th Annual Conference of Engineering and Implementation on Vocational Education (ACEIVE 2024)*, Advances in Social Science, Education and Humanities Research 919, https://doi.org/10.2991/978-2-38476-398-6_10

The world is currently transitioning into the era of transformation 5.0, a phase marked by the significant replacement of human activities with artificial intelligence [5]. The Japanese government introduced Society 5.0 in 2019, building upon the advancements of the Industrial Revolution 4.0 through the integration of artificial intelligence [6]. Over the past two years, the rapid flow of information has signaled the shift from the 4.0 era to 5.0 [7]. The focus of this new era lies in leveraging technology and information across various sectors, including education [8]. The education sector is undergoing transformative changes to align with advancements in science and technology, ensuring it remains relevant [9]. A notable aspect of this educational revolution is the pivotal role of technology in shaping learning processes, influencing how students engage with teachers and peers. The transformation of society 5.0 extends across all domains, compelling education to continuously adapt to meet evolving demands and produce skilled and competent human resources.

In the Society 5.0 era, education plays a crucial role in realizing national education objectives by fostering an engaging learning environment and improving the overall quality of education [10]. The fusion of science and technology in education opens up avenues to elevate educational standards and drive innovation in teaching and learning processes [11]. Consequently, education must keep pace with advancements in science and technology [12]. In this era, there is a strong emphasis on active student participation, collaboration, and the enhancement of learning outcomes through the application of cutting-edge technologies such as artificial intelligence, machine learning, virtual reality, and the Internet of Things [9]. Additionally, the focus is on cultivating 21st-century competencies like creativity, critical thinking, communication, and teamwork [13]. Moreover, education in this era encourages the development of inclusive, skills-focused learning strategies that align with contemporary trends [14]. To meet these expectations, education systems must transform to reflect the principles of Society 5.0, ensuring ongoing improvements in educational quality.

Research indicates that the digital education transformation in the 5.0 era, driven by the integration of scientific and technological innovations, significantly enhances the quality of education [9]. Education in this era provides opportunities to align learning with contemporary needs, enabling students to engage in independent, interactive, and enjoyable learning experiences [15]. The educational framework of the 5.0 era evolved as a response to the 4.0 era, aiming to enhance graduates' soft skills, digital technology competencies, and their practical applications. This involves the implementation of artificial intelligence, big data, and the Internet of Things in the educational domain [16]. Education in the Society 5.0 era fosters innovations that empower students to actively explore, discover, discuss, think critically, and innovate [17]. However, the transition to this new era is not without challenges and negative impacts. One significant challenge is the lack of adequately skilled human resources to support technology-intensive education [18]. Additionally, reliance on technology has been associated with reduced direct social interactions [15]. Like any transformation, the shift from education in the 4.0 era to 5.0 comes with both advantages and drawbacks. This research seeks to explore the ongoing transformation in education during the 5.0 era, with a focus on the use of technology in learning.

Furthermore, it aims to analyze the opportunities and challenges arising from this transformation.

2 Research Methodology

This study adopts a qualitative descriptive research approach, which aims to present a comprehensive depiction of the phenomenon under investigation. A literature review method is employed by gathering, analyzing, and interpreting secondary data from credible sources, including scientific journals, books, research reports, and articles relevant to the subject. This process involves critically examining theories and prior research findings to uncover patterns, trends, and gaps within the existing literature. Using this method, the study aims to give a complete and in-depth understanding of the subject at hand, based on real-life examples and well-known theories [19].

3 Results and Discussion

3.1 Education Transformation in the 5.0 era

The advancement of human civilization aligns with the progression of time, leading humanity into the 5.0 era. Essentially, the 5.0 revolution emerged due to growing concerns about the increasing replacement of human roles by machines. The utilization of human resources has declined as machines and robots take over [20]. Revolution 5.0 aims to address challenges and mitigate the negative impacts of its predecessor. A key aspect of the 5.0 era is fostering collaboration between humans and technology, ensuring that humans are not entirely replaced but instead maintain control over technological advancements. Society 5.0 envisions a community capable of addressing social challenges and issues by leveraging innovations from the Industrial Revolution 4.0, including the Internet of Things (IoT), Artificial Intelligence (AI), Big Data, and robotics, to enhance human life quality [21]. This era emphasizes integrating human resource competencies with technological sophistication to achieve efficiency and effectiveness across various sectors, including education. The development of numerous learning applications accessible anytime and anywhere allows individuals to engage in virtual learning. Additionally, the incorporation of artificial intelligence in the educational process provides valuable support, while human resources remain central to driving innovation. We expect these educational innovations to resolve challenges and introduce improvements beyond previous approaches.

The transformation of education in the Society 5.0 era represents a shift in the education system to address the challenges and seize the opportunities presented in this new era. Society 5.0 harmoniously integrates digital technology with human life, prioritizing social and individual well-being while enhancing human potential through technological innovations. This transformation fosters education that is more inclusive, adaptable, and aligned with contemporary demands. Significant advancements in this era include the integration of artificial intelligence (AI) with

humans as the central focus, enabling the completion of tasks more effectively. AI simplifies various aspects of education, improving both visibility and comprehensiveness. Examples of AI applications in education include chatbots like Google Assistant and learning management systems such as Moodle, Blackboard, and Canvas, which leverage AI to enhance learning experiences. Platforms like Duolingo also provide real-time feedback. The incorporation of AI in education has been shown to improve student learning outcomes by offering greater understanding, facilitating faster, real-time feedback, and addressing individual learning needs [22].

AI technology enables personalized learning through the application of machine learning algorithms. By analysing student data and individual preferences, AI creates customized learning experiences that align with each student's unique needs. This approach enhances student engagement and supports them in achieving their full potential [23]. Furthermore, artificial intelligence delivers tailored educational experiences for students [24]. Its implementation positively impacts the development of education and contributes to improved learning outcomes.

3.2 Big Data and Internet of Things

Big data refers to the process of storing and analyzing vast quantities of data in various formats. As implied by its name, big data encompasses diverse digital data that can be rapidly processed to generate valuable insights [25]. It integrates advanced technologies designed to handle massive datasets with high speed and accuracy during analysis and response [26]. By leveraging big data, quick and accurate access to extensive information becomes possible, significantly supporting activities across multiple sectors such as healthcare, finance, and education [27].

The integration of Big Data in education is no longer a mere concept but has been realized in various institutions. Through specialized software, students' focus and learning progress can be analyzed effectively. This software gathers data from students' devices, including grades, study habits, strengths and weaknesses, as well as hesitation patterns when interacting with a computer mouse [28]. The advancement of technology in the Big Data era has significantly influenced education, particularly in the development of online learning platforms [29]. In the education sector, Big Data plays a crucial role by generating valuable insights for decision-making processes in higher education [30]. These decisions are driven by data and relevant information [31]. Furthermore, Big Data enhances the effectiveness of distance learning by evaluating student engagement and performance in virtual learning environments [32].

The Internet of Things (IoT) refers to a concept where various physical devices are connected to the internet, enabling them to communicate and exchange data autonomously. These devices include sensors, cameras, household appliances, vehicles, and even wearable items equipped with technology to transmit and receive data through the internet. In the field of education, IoT plays a significant role in facilitating the monitoring and management of educational activities. Examples include controlling entry and exit points, monitoring library access, and tracking attendance for students and staff. The implementation of IoT in higher education can also yield various benefits, such as energy efficiency, health monitoring,

administrative improvements, and even transforming traditional business models in the education sector [33]. According to education experts, IoT has a profound positive influence on education, offering solutions to numerous challenges [34]. This research aims to analyze and categorize the positive impacts of IoT on education while exploring its role in shaping future smart education systems. Furthermore, IoT is crucial in the development of smart campuses [33].

3.3 21st Century Transformation

The Minister of Education and Culture Regulation No. 21 of 2016 emphasizes that the Graduate Competency Standards in the 2013 curriculum are aligned with 21st-century competencies. These competencies focus on the development of essential soft skills, encapsulated in "The 4C Skills," which include critical thinking, communication, collaboration, and creativity. This indicates that relying solely on hard skills is inadequate to address the challenges of 21st-century transformation. A balanced integration of hard skills and soft skills is essential for success in this era.

We certainly need to hone these soft skills within the scope of learning. Students can cultivate critical thinking, communication, collaboration, and creativity in a variety of ways. Applications of learning, such as problem-based learning, require students to think critically in order to solve existing problems. This approach will be able to produce thoughts and concepts regarding the given problem so that the ability to think critically becomes sharper [35]. In addition to PBL, project-based learning serves as another effective method for skill enhancement. PJBL provides space for students to be able to hone creativity, communication, and collaboration together with their teammates. This learning has the concept that studying is not just receiving information but also being actively involved in seeking knowledge [36].

3.4 Opportunities and Challenges for Implementing Educational Technology Innovation

The industrial revolution 5.0 has introduced substantial transformations across various sectors, including education. This era focuses on synergy between humans and intelligent technologies, such as artificial intelligence (AI), the Internet of Things (IoT), and big data, which are seamlessly integrated into daily life to offer more adaptive and customized solutions. In the realm of education, these technologies hold immense potential to enhance accessibility, quality, and the overall effectiveness of learning processes. Nevertheless, alongside these promising prospects, significant challenges persist, particularly in developing nations like Indonesia, where limitations in infrastructure and human resource preparedness remain pressing issues.

The approach to how students learn and engage with teachers and peers has undergone significant changes. Integrating technology into education introduces new challenges, such as reduced social interaction between students and teachers and the absence of a comprehensive learning experience [37]. Additionally, the implementation of technology in Indonesia faces considerable hurdles due to the wide educational disparity. Numerous schools in Indonesia still lack adequate facilities and infrastructure [38]. Without meeting the necessary infrastructure standards, integrating technology into the learning process becomes a significant challenge.

It is important to address the teacher's ability to effectively incorporate technology into their teaching approach, as this represents a significant challenge. Teachers, who serve as the primary facilitators of knowledge and engage directly with their students, are expected to utilize technology seamlessly in their instructional practices [39]. However, studies indicate that many teachers continue to face difficulties with technology integration. This presents an obstacle to technology-enhanced learning and underscores the need for proper training prior to implementation.

4 Conclusion

Educational transformation in the Society 5.0 era is an ongoing process that requires commitment from all parties, including the government, schools, teachers, parents, and students. We hope that with the right educational transformation, Indonesia's youth can become superior human resources and compete in the global era. In the education sector, technology integration has been in place for quite some time, although its implementation has not been evenly distributed. Technologies such as artificial intelligence, the Internet of Things, and big data have become well-known and integrated into education. However, Indonesia also faces challenges, as existing limitations prevent equal distribution across all regions.

Acknowledgments. The authors express their sincere gratitude to Institut Agama Kristen Renatus (IAKR) Pematang Siantar and Sekolah Tinggi Teologi Amsal Medan for their support in facilitating this research. Special thanks are extended to colleagues and experts who provided valuable insights and constructive feedback, which significantly contributed to enhancing the quality of this study. The authors also acknowledge the scholarly references that formed the foundation of this research.

Disclosure of Interests. The authors have no competing interests to declare that are relevant to the content of this article.

References

1. Tundjung, Noviyanti, R.: Revolusi Industri dan Pengaruhnya Pada Penelitian Sejarah. *Jurnal Pendidikan Sejarah* **4**(2), (2021)
2. Fajariah, M., Suryo, D.: Sejarah Revolusi Industri di Inggris Pada Tahun 1760-1830, *Historia: Jurnal Program Studi Pendidikan Sejarah* **8**(1), 77 (2020)
3. Siaran Pers.: Making Indonesia 4.0: Strategi RI Masuki Revolusi Industri Ke-4., March (2018)
4. Dito, S. B., Pujiastuti, H.: Dampak Revolusi Industri 4.0 Pada Sektor Pendidikan: Kajian Literatur Mengenai Digital Learning Pada Pendidikan Dasar dan Menengah. *Jurnal Sains dan Edukasi Sains* **4**(2), 59–65 (2021)
5. Lian, B.: Transformasi Pendidikan di Era Society 5.0. In: Seminar Nasional Program Pascasarjana 2022, Universitas PGRI Palembang, November.
6. Sakinah, A. N., Mahya, A. F. P., Santoso, G.: Revolusi Pendidikan di Era Society 5.0; Pembelajaran, Tantangan, Peluang, Akses, dan Keterampilan Teknologi. *Jurnal Pendidikan Transformasi* **1**(2), (2022).

7. Rakhmawati, D.: Konselor Sekolah Abad 21; Tantangan dan Peluang. *Jurnal Konseling Gusjigang* 3(1), (2017)
8. Aiman, K.: Paradigma Pendidikan Inklusi Era Society 5.0. In: *Seminar Dan Diskusi Pendidikan Dasar* (2020)
9. M. J. D., Yusuf, R. T.: Transformasi Pendidikan Digital 5.0 melalui Integrasi Inovasi Ilmu Pengetahuan dan Teknologi. *Jurnal MENTARI Manajemen, Pendidikan dan Teknologi Informasi* 2(1), 11–19 (2023)
10. Nadeak, H.: Transformasi Dunia Pendidikan Pada Era Industri 5.0 Di Indonesia. *Journal of Social Science Research*, 1188–1195 (2024).
11. Driscoll, A. K.: Maternal Characteristics and Infant Outcomes of Women Born in and Outside the United States, 2020. *Vital Health Stat* 3, **June**(48), 1-66 (2022).
12. Dian Sudiantini, Mayang Puspita Ayu, Muhammad Cheirnel All Shawirdra Aswan, Meyliana Alifah Prastuti, and Melani Apriliya.: Transformasi Digital: Dampak, Tantangan, Dan Peluang Untuk Pertumbuhan Ekonomi Digital. *Trending Jurnal Manajemen dan Ekonomi*, 1(3), 21–30 (2023).
13. Santoso, G.: The Structure Development Model of Pancasila Education and civic Education at 21st Century 4.0 Era in Indonesia. In *Proceedings of The 2nd African International Conference on Industriial Engineering and Operations Management Harare*, 2020, pp. 175–210.
14. Putra, Y. I., Hakiki, M., Ridoh, A., Fauziah, S. P., Sundahry, S. P.: Konsep Interaksi Manusia dan Komputer, Lakeisha, **8** (2022)
15. Fricticarani, A., Hayati, A., Hoirunisa, R. R. I., Rosdalina, G. M.: Strategi Pendidikan Untuk Sukses Di Era Teknologi 5.0. *Jurnal Inovasi Pendidikan dan Teknologi Informatika* 4(1), 56–68 (2023)
16. Subandowo, M.: Teknologi Pendidikan di Era Society 5.0. *Sagacious Jurnal Ilmu Pendidikan Dan Sossial* 9(1), 24–35 (2022).
17. Ma’rufah, L. A., Arsanti Meilan.: Inovasi dan Strategi Pembelajaran untuk Menghadapi Era Society 5.0. In: *Prosiding Senada (Seminar Nasional Daring)* (2022)
18. Ismunandar, A., Rini, A. P.: Implikasi Era Revolusi Industri 4.0 Terhadap Pengembangan Kemampuan Sumber Daya Manusia di Perguruan Tinggi. *Jurnal Review Pendidikan dan Pengajaran* 7(2), (2024).
19. Sugiyono.: *Media Penelitian Kuantitatif, Kualitatif dan R&D*. Alfabeta (2016).
20. Yolanda.: Menyiasati Dampak Era Revolusi Industri 4.0 Terhadap Perekonomian Indonesia. *Jurnal Ekonomi* 21(3), (2019).
21. Williamson, B.: *Big Data in Education, the Digital Future of Learning, Policy and Practice.*, SAGE. (2017)
22. Robiul, D., Arya, I., Zakariyya, A.: Manfaat Kecerdasan Buatan Untuk Pendidikan. *Jurnal Teknologi Komputer dan Informasi*, 124–134 (2023).
23. Mambu J. G. Z., Dedek Helida Pitra, Aziz Rizki Miftahul Ilmi, Wahyu Nugroho, Natasya V Leuwol, Andi Muh Akbar Saputra.: Pemanfaatan Teknologi Artificial Intelligence (AI) Dalam Menghadapi Tantangan Mengajar Guru di Era Digital. *Journal on Education* 6(1), 2689–2698 (2023).
24. Maufidhoh, I., Maghfirah, I.: Implementasi Pembelajaran Berbasis Artificial Intelligence Melalui Media Puzzle Maker Pada Siswa Sekolah Dasar. *Abuya Jurnal Pendidikan Dasar*, (2023).
25. Liliana, L., Vera, D., Surya Wijaya, A., Yurisca Bernanda, D. S.: Informasi, and Bunda Mulia, *Penggunaan Big Data Untuk Menganalisis Tingkat Keberhasilan Siswa Menempuh Mata Kuliah 2019*, Jakarta (2019)
26. Saputra, A., Firdaus, M. I., Wahyudi, Mohdo, Gunawan, and Encep.: *Big Data*, (2022).

27. Tasueva, M., Vazkayeva, S., Akhmadov, A.: Big Data and Its Application in Various Industries. In SHS Web of Conferences (2023).
28. Efgivia, M. G.: Pemanfaatan Big Data Dalam Penelitian Teknologi Pendidikan. *Jurnal Teknologi Pendidikan* **5**(2), 107–120 (2020).
29. Umar.: Pendekatan Pembelajaran Dari Berbasis ICT ke Era Big Data. Reorientasi Pembelajaran dalam Paradigma Konstruktivisme. *Jurnal Kajian Islam dan Pendidik* **9**(1), (2017).
30. Guerrero, C., Acosta, Sierra, J. E.: Creation of Value Through Big Data in Higher Education Institution A Survey, *Journal of. English Applied Science* **14**(4), (2029).
31. Agustini, K.: Inovasi Teknologi dalam Pendidikan Melalui Big Data Analytic dan Personalized Learning. In: Seminar Nasional Pendidikan Teknologi Informasi, pp. 10–14. (2017)
32. Wulandari, A. A., Asih, A. S., Pratama, H. D., Azzahra, L., Winaya, R. R.: Pengaruh Big Data Terhadap Keefektifan Microsoft Teams Sebagai Sarana Pembelajaran. *Jurnal Pengabdian Pendidikan dan Teknologi* **4**(2), 69 (2024)
33. Kristianti, N.: Pengaruh Internet Of Things (IOT) Pada Education Business Model : Studi Kasus Universitas Atma Jaya Yogyakarta. *Jurnal Teknologi Informasi* **13**(2), (2019).
34. Bocken, N. M. P., Short, S. W., Rana, P., Evans, S.: A literature and practice review to develop sustainable business model archetypes. *Journal of Cleaner Production* **65**, 42–56 (2014)
35. Ardianti, R., Sujarwanto, E., Surahman, E.: Problem-based Learning: Apa dan Bagaimana. *Diffraction* **3**(1), 27–35 (2022)
36. Jusmardi, J. W., Kurniawan, A., Deswina, M., Febrianti, N.: Project Based Learning: Strategi Efektif Untuk Meningkatkan Creative Thinking Ability. *Jurnal Pendidikan Teknologi Informasi dan Vokasional* **5**(2), (2023)
37. Santoso.: Civic Education Based on 21st Century Skills in Philosophical, Theoretical and Futurist Resolution Dimensions at Muhammadiyah University of Jakarta. *Journal of Entrepreneurship & Project Digital Management* **1**(2), (2021)
38. Khairunnisa Santoso, Azzahra, Adisti.: Filsafat Konten Nasionalisme, Patriotisme, dan Perjuangan. *Jurnal Pendidikan Transformatif* **2**(1), (2023).
39. Rofii, A., Nurhidayat, E., Firharmawan, H., Prihartini, E.: Pelatihan Peningkatan Professional Competence Guru Dalam Mengintegrasikan Teknologi Dalam Pembelajaran Di Mgmp Bahasa Inggris Smk Kab.Majalengka. *BERNAS Jurnal Pengabdian kepada Masyarakat* **4**(3), 1915–1921 (2023)

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

