

THE INFLUENCE OF DIGITAL TECHNOLOGY DEVELOPMENTS ON VOCATIONAL SCHOOL CURRICULUM IN MEETING THE NEEDS OF HUMAN RESOURCES IN THE INDONESIAN EDUCATION

Yuanita Sabrina^{*}, Muhammad Ustman Amrul Hamzah, Yuni Muliwana, Asti Fatimah, Laras Chaerani

Pendidikan Teknologi Dan Kejuruan, Fakultas Teknik, Universitas Negeri Jakarta
Jalan Rawamangun Muka, Jakarta Timur, 13220, Indonesia
Email: yuanitasabrina@gmail.com

Abstract

The rapid development of digital technology in the era of the Fourth Industrial Revolution (Industry 4.0) and Society 5.0 has brought significant transformation to vocational education, particularly within Indonesian vocational high schools (SMK). This transformation requires a curriculum that is adaptive, integrative, and aligned with the needs of the business sector, industry, and the labor market (DUDIKA). This study aims to analyze how digital technology influences the design, implementation, and effectiveness of the SMK curriculum in preparing competent graduates who meet modern industrial demands. The research employed a Literature Study (LS) method by reviewing 10 scientific articles related to digital technology, curriculum development, teacher competencies, student competencies, and vocational education policies. The findings reveal that the integration of digital technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), and Teacher Digital Competencies (TDC) plays a crucial role in increasing the relevance of vocational learning to current industry needs. These technologies not only enhance instructional methods but also support the development of digital literacy, creativity, problem-solving abilities, and students' understanding of digitalized industrial processes. However, the implementation of digital-based learning still faces significant challenges, including limited infrastructure, gaps in teachers' digital competencies, insufficient industrial simulation facilities, and unequal collaboration between SMK institutions and industry partners. The literature review further indicates the existence of a competency gap between what is taught in SMK and what is required by industry, particularly in terms of operating industrial digital platforms and analyzing automated data. Therefore, strengthening the curriculum requires continuous digital integration, teacher training, improved digital facilities, and systematic collaboration with industry stakeholders. In conclusion, the SMK curriculum must be continuously modernized to address the challenges and opportunities of the digital era and to produce graduates who are competent, adaptive, and ready to compete in the global workforce.

Keywords: Digital Technology, SMK Curriculum, DUDIKA

INTRODUCTION

The development of digital technology in the era of the Industrial Revolution 4.0 and Society 5.0 has driven major transformations in vocational education, including in Vocational High Schools (SMK). This transformation occurs in several aspects such as learning methods, curriculum structure, teacher competencies, learning outcomes, and graduates' readiness to meet the needs of the business sector, industry, and the labor market (DUDIKA). Digital technology is no longer secondary; it has become the foundation of future curriculum design, which requires mastery of digital skills, data literacy, programming, the Internet of Things (IoT), Artificial Intelligence (AI), Teacher Digital Competencies (TDC), and simulation-based digital tools.

Various studies indicate that digital transformation in SMK requires strengthening technology-based curricula. A study by Alvendri et al. (2023) emphasized that integrating IoT into vocational learning enhances the relevance of students' learning experiences with modern industry needs, although its implementation is still constrained by teacher readiness and available facilities. Similarly, Wardoyo et al. (2024) found that the use of digital technologies such as practice simulations, virtual training, and interactive media improves the quality of practical learning by up to 70%, but implementation remains uneven across SMKs.

In terms of strengthening teacher competencies, Cattaneo et al. (2022) show that vocational teachers need digital competencies that include technical skills, digital pedagogical abilities, media creativity, and data protection. These findings are reinforced by Harianto (2024), who revealed that the integration of digital technology into the Merdeka Curriculum enhances teacher professionalism, particularly in learning creativity, time management, utilization of digital media, and the development of digital-based teaching materials. Nevertheless, gaps in digital competence remain, indicating the need for continuous training for educators.

The use of digital technology also affects the improvement of student learning quality. Research by Rachmat et al. (2025) demonstrated that the use of a mobile-application-based E-Training System can increase students' discipline and learning outcomes in productive subjects at SMK. Effectiveness testing showed an N-Gain score of 0.76 (high category), indicating that technology-based learning can improve competency mastery and student motivation. Meanwhile, Arifin et al. (2024) found that the use of Generative AI in learning enhances students' digital literacy, creativity, and problem-solving skills, showing that digital technology is highly relevant to the needs of modern vocational learning.

From the perspective of vocational education policy, Maulana (2023) emphasized that optimizing vocational education requires fulfilling infrastructure needs, improving the quality of educators, and aligning the curriculum with industry needs through link-and-match policies. These findings align with research by Fatmawati et al. (2024), which states that curriculum development significantly influences the fulfillment of industrial needs, especially when mediated by education quality, while resource availability has not yet shown an optimal impact. Additionally, Purnomo et al. (2025) highlight that the Merdeka Curriculum provides flexibility for SMKs to develop project-based learning and teaching factories, but still faces challenges related to teacher readiness and digital infrastructure.

Based on the synthesis of the 10 scientific articles reviewed by our group, a consistent pattern emerges: the development of digital technology has a significant influence on the

direction and implementation of the SMK curriculum. However, the readiness of educational units still shows gaps between industry demands and graduates' competency achievements. Thus, this literature review emphasizes that modernizing the SMK curriculum cannot progress without the support of adequate infrastructure, teacher training, DUDIKA collaboration, and government policy interventions.

RESEARCH METHODS

This study employs the Literature Study (LS) method, a research approach conducted through the examination of various relevant scientific sources to understand the influence of digital technology developments on the SMK curriculum in meeting the human resource needs of DUDIKA. This method enables researchers to gain a comprehensive understanding of conceptual developments, policy changes, and empirical findings on vocational education from multiple perspectives. Research data were collected through the identification and review of 10 scientific articles published in accredited national journals and open-access international journals, focusing on topics related to vocational education, curriculum development, digital technology, teacher and student competencies, industry needs, and the implementation of the Merdeka Curriculum. The articles were selected based on substantial relevance to the research topic and their publication range from 2019–2025, ensuring alignment with the current context of digital technology advancements.

Each article was analyzed using a content analysis approach by extracting key findings related to the integration of digital technology in learning, curriculum alignment with industry needs, teacher readiness in digital transformation, the effectiveness of application-based learning, and challenges in curriculum implementation at the school level. The collected information was then categorized into main thematic groups to identify patterns and general trends emerging across previous studies. Through this synthesis process, the study formulates a comprehensive understanding of how digital technology developments influence the direction of SMK curriculum development and the extent to which the curriculum is able to meet the skill demands of the business sector, industry, and the labor market.

This literature study approach ensures that all discussions and arguments in the article are based on scientific evidence, empirical findings, and strong theoretical frameworks, resulting in a credible analysis of the challenges and opportunities in developing the SMK curriculum in the digital era.

RESULTS AND DISCUSSION

According to Law Number 20 of 2003 concerning the National Education System Law, the curriculum is defined as a set of plans and arrangements regarding objectives, content, learning materials, and teaching methods used as guidelines for organizing learning activities to achieve specific educational goals. In Vocational High Schools (SMK), the curriculum holds strategic relevance in preparing the workforce because it is designed not only to achieve educational goals theoretically but also to equip students with vocational competencies that align with the needs of the business sector, industry, and the labor market (DUDIKA). As both a normative and practical document, the SMK curriculum integrates academic aspects and

technical skills. This aligns with the mandate of Law No. 20 of 2003, which states that the goal of vocational education (SMK) is to prepare students, primarily to work in specific fields.

As times change, the curriculum must continuously adapt, and this adaptation is strongly influenced by digital technology. The development of digital technology drives the enhancement of curricula that are relevant to contemporary needs. The curriculum has strongly connected with digital technology because it functions as an adaptive instrument that ensures education remains aligned with scientific developments and the demands of the Industrial Revolution 4.0 era. In this context, the curriculum not only outlines learning objectives and content but must also integrate digital literacy, information technology skills, and the use of digital tools as part of the teaching–learning process. Thus, the curriculum becomes a strategic foundation for preparing vocational students to adapt to digital transformation, master technology-based competencies, and remain competitive in a global job market that increasingly emphasizes innovation, collaboration, and technology-based problem-solving.

Integrating a digital-technology-based SMK curriculum is a strategic step to ensure that graduates possess competencies that are relevant to the demands of the Industrial Revolution 4.0 and Society 5.0. The curriculum functions not only as a learning guideline but also as a policy instrument that links the needs of the business and industrial sectors with the educational process. By incorporating digital literacy, software utilization, and computer-based simulations, this integration positions the SMK curriculum as a medium for transformation, enabling vocational education to play an active role in producing skilled workers who are ready to face technological disruption and remain competitive in the global market. Efforts to integrate digital technology into the SMK curriculum may involve elements such as IoT, AI, and TDC (Teacher Digital Competencies).

The Internet of Things (IoT) is a concept that involves connecting physical objects to the internet, enabling data exchange and interaction between them. Its application has expanded across various industries, including manufacturing, transportation, healthcare, and agriculture. For example, in the manufacturing industry, IoT can be used to monitor and optimize production processes, reduce time and costs, and improve product quality. Future vocational education must therefore be capable of responding to the challenges of the increasingly advanced digital and Industrial 4.0 era (Alvendri et al., 2023).

Artificial Intelligence (AI) is a field of computer science focused on developing systems capable of imitating human intelligence, including learning, reasoning, understanding language, and making decisions (Sheikh et al., 2023). Its utilization in improving students' digital competence particularly through Generative AI has shown significant positive results. Research indicates substantial increases in students' understanding after participating in Generative AI based training. This technology not only assists students in generating digital content but also improves creativity, digital literacy, and problem-solving skills (Arifin et al., 2025).

Teacher Digital Competencies (TDC) in the context of vocational education refer to the ability of teachers to effectively integrate digital technology into the learning process, including technical skills, conceptual understanding, attitudes toward technology, and pedagogical ability to utilize digital tools. TDC is not merely about mastering technological devices; it represents a multidimensional competency that involves technical, cognitive, ethical, and motivational aspects. Vocational teachers are required not only to use technology but also to possess

adequate digital literacy to prepare students for an increasingly digitalized workforce (Cattaneo et al., 2022).

The development of a digital-technology-based SMK curriculum has implications for transforming vocational education, enabling it to function not only as a normative instructional guide but also as a strategic instrument that connects education with the needs of the business sector, industry, and labor market (DUDIKA). A curriculum that adapts to technological advancements ensures the integration of digital literacy, information technology skills, and digital tools into the teaching–learning process, ultimately producing graduates whose competencies are aligned with the demands of the Industrial Revolution 4.0 and Society 5.0.

The application of technologies such as the Internet of Things (IoT) enables real-industry simulations; Artificial Intelligence (AI) enhances creativity, digital literacy, and problem-solving skills; while Teacher Digital Competencies (TDC) require vocational teachers to possess multidimensional abilities in integrating technology pedagogically. The direct implication of this integration is the creation of a globally competitive workforce capable of adapting to technological disruption, mastering both vocational and digital skills, and demonstrating the technical, cognitive, ethical, and social competencies required by the modern labor market.

Descriptions of challenges related to the gap between industry needs and the SMK curriculum are also aligned with findings of recent studies. Research by Fatmawati et al. (2024) shows that the curriculum development process significantly influences industrial needs, while human resource readiness and education quality remain major obstacles in achieving ideal link-and-match conditions. These findings are consistent with Purnomo et al. (2025), revealing that the implementation of the Merdeka Curriculum in SMK still faces gaps due to limited digital infrastructure and insufficient teacher readiness to utilize learning technologies. This illustrates the reality that many schools are still unable to keep pace with the demands of digital industry competencies, including mastering simulation tools, industrial technology platforms, and digital collaboration.

These gaps underscore that integrating technology into the SMK curriculum requires reinforcement in the areas of policy, infrastructure, and teacher capacity so that students are genuinely prepared for the needs of the modern digital industry. The importance of addressing these gaps and enhancing teacher capacity is also reflected in the recommendations of Mangesa et al. (2024), which highlight the need for developing teacher competencies through more intensive digital literacy training and improving technological infrastructure in schools.

CONCLUSION

Based on the description of the results and discussion, it can be concluded that the SMK curriculum plays a strategic role in preparing graduates who are competent and aligned with the needs of the business sector, industry, and the labor market (DUDIKA). The development of digital technology has reinforced the need for a curriculum that is adaptive, integrative, and responsive to the demands of the Industrial Revolution 4.0 and Society 5.0. The integration of digital technology through digital literacy, the use of the Internet of Things (IoT), Artificial Intelligence (AI), and the strengthening of teachers' digital competencies are essential steps that can improve the quality of vocational learning and ensure that graduates possess the skills required in the modern workforce.

Although digital integration has begun to be implemented, various findings indicate that its implementation has not yet been optimal. In many educational institutions, curriculum development has been directed toward fulfilling industrial needs; however, infrastructure, teacher readiness, and the quality of learning processes are still uneven. Some schools continue to face limitations in digital facilities and teachers' digital pedagogical skills, preventing technology use from fully improving learning quality. In addition, industry involvement in curriculum alignment remains inconsistent, resulting in gaps between the competencies students learn and those required in the field.

These gaps are particularly visible in the ability to use industrial digital platforms, understand automation data, and collaborate in digital environments. This condition indicates that further reform of the digital-technology-based curriculum is still needed to ensure alignment between industrial demands and student learning outcomes. The curriculum must be designed in a more adaptive, flexible, and sustainable manner to keep pace with the rapid advancement of technology.

Overall, the development of digital technology not only opens opportunities to enhance the quality of vocational education but also introduces new challenges regarding human resource readiness, infrastructure, and learning processes. Therefore, efforts to modernize the SMK curriculum must be carried out comprehensively by strengthening curriculum development, improving teacher capabilities, providing adequate digital facilities, and establishing continuous collaboration with industry. This approach is necessary to ensure that vocational education produces graduates who are competent, adaptive, and ready to compete in an increasingly digitalized workforce.

REFERENCES

- Alvendri, D., Giatman, M., & Ernawati. (2023). Transformasi Pendidikan Kejuruan: Mengintegrasikan Teknologi IoT ke dalam Kurikulum Masa Depan. *Journal of Education Research*, 4(2), 752–758. <https://doi.org/10.37985/jer.v4i2.244>
- Arifin, R. W., Alfian, A. N., Sumardiono, & Awiliyanto, R. R. (2025). Pengembangan Skill Digital Siswa SMK melalui Pemanfaatan Generatif AI. *Jurnal Bhakti Karya Dan Inovatif*, 5(1), 63-72. <https://doi.org/10.37278/bhaktikaryadaninovatif.v5i1.1072>
- Cattaneo, A. A. P., Antonietti, C., & Rauseo, M. (2022). How Digitally Competent Are VET Teachers? Assessing Teachers' Digital Competence in Vocational Education and Training. *Computers & Education*, 176(104358), 1-18. <https://doi.org/10.1016/j.compedu.2021.104358>
- Fatmawati,. dkk. (2024). Analisis Ketersediaan Sumber Daya dan Proses Pengembangan Kurikulum terhadap Kebutuhan Industri Dimediasi oleh Mutu Pendidikan di SMK Negeri 8 Samarinda Provinsi Kalimantan Timur. *Jurnal Dinamika Manajemen Berkelanjutan*, 5(3), 1-31. <https://ejournals.com/ojs/index.php/jdmb>
- Hariato, G. H. (2024). Kajian Dampak Penerapan Integrasi Teknologi Terhadap Kompetensi Profesional Guru Dalam Pelaksanaan Pembelajaran Dengan Kurikulum Merdeka. *Seminar Nasional Pendidikan (SNP) 2024*, 1(1), 482-491. <https://conference.untan.ac.id/index.php/snp>
- Mangesa, M., dkk. (2024). Analisis Implementasi Literasi Digital dalam Pembelajaran pada Kurikulum Merdeka di SMK. *Seminar Nasional Hasil Penelitian 2024*, 9(19), 1853. <https://ojs.unm.ac.id/semnaslemlit/article/view/67661>
- Maulana, A. (2023). Optimalisasi Pendidikan dan Pelatihan Vokasi di Indonesia. *Jurnal Pembangunan dan Administrasi Publik*, 5(1), 1-8. <https://jurnal.stialan.ac.id/index.php/jpap/article/view/680>
- Purnomo, A., Maulida, A. F., Lukitasari, D. F., Lestari, T. S. P. P., Prastika, V., & Murniati, N. A. N. (2025). Pengembangan Kurikulum Merdeka terhadap perubahan dan kebutuhan DUDIKA. *JANACITTA: Journal of Primary and Children's Education*, 8(2), 1–7. <https://doi.org/10.35473/janacitta.v8i2.4000>
- Rachmat, B. N., dkk. (2025). Pengembangan E-Training System Berbasis Aplikasi Seluler Dalam Meningkatkan Kedisiplinan Dan Hasil Belajar Siswa Pada Mata Pelajaran Gambar Teknik Di SMK Turen. *Jurnal Pendidikan Vokasi Otomotif*, 7(2), 107-128. <https://journal.um.ac.id/index.php/jpvo>
- Republik Indonesia. (2003). Undang-Undang Nomor 20 Tahun 2003 tentang Sistem Pendidikan Nasional. *Lembaran Negara Republik Indonesia Tahun 2003 Nomor 78*. Jakarta: Sekretariat Negara, 6-7, 22-23. <https://peraturan.bpk.go.id/Details/43920/uu-no-20-tahun-2003>
- Sheikh, H., dkk. (2023). Artificial intelligence: Definition and background. Dalam *Mission AI*, Cham: Springer. ISBN 978-3-031-21448-6, 15–41. https://link.springer.com/chapter/10.1007/978-3-031-21448-6_2
- Wardoyo, S., Hidayat, J., Khoirunnisa, N., & Saepullah, M. Z. (2025). Pengaruh Transformasi Digital terhadap Pengajaran Berbasis Praktik di Pendidikan Vokasi. *Jurnal Informatika dan Teknik Elektro Terapan*, 13(1), 514-521. <https://doi.org/10.23960/jitet.v13i1.5669>