

The Strategic Role of Vocational High Schools in Facing Technological Disruption: A Critical Review and Implications

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Abstract: Technological advances in the Industrial Revolution 4.0 era and the shift towards Society 5.0 require Vocational High Schools to produce graduates who are competent, relevant, and able to adapt to the dynamics of the modern workplace. This study aims to critically analyze the strategic role of vocational high schools in preparing human resources with optimal work readiness. Through a systematic review of 15 studies published between 2021 and 2025, this study identified four main themes: student work readiness, graduate competency relevance, curriculum challenges, and digital competency. The synthesis results indicate that graduate work readiness is shaped by the integration of technical competencies, employability skills, digital literacy, critical thinking skills, industrial practice experience, and psychological aspects such as career adaptability, with soft skills being the most dominant factor. This study also identified several obstacles that reduce graduate relevance, including mismatching competencies with industry needs, a less adaptive curriculum, low teacher digital readiness, and unsustainable industry partnerships. These findings emphasize the importance of curriculum synchronization, strengthening teachers' pedagogical and digital competencies, optimizing fieldwork practices, and expanding school-industry collaboration. This study has limitations such as the limited number of studies, potential selection bias, and focus on the Indonesian context. Therefore, further research is recommended to test the effectiveness of the IVRM Model using mixed methods, assess the implementation of micro-credentials in various skill programs, and conduct longitudinal studies on the impact of teaching factory implementation and industry partnerships.

Keywords: Adaptive Curriculum, Digital Literacy, Employability Skills, School-Industry Collaboration, Vocational Students' Work Readiness

A. Introduction

The Industrial Revolution 4.0 continues to evolve and transition towards Society 5.0, creating new and more complex challenges, including the rapid flow of globalization, increasingly rapid technological advancements, human migration between regions and countries, creating intense competition, changes in all fields,

and environmental challenges. Therefore, vocational education institutions are required to equip graduates with competencies capable of competing in today's era of technological disruption. Companies often seek soft skills, such as critical and analytical thinking, problem-solving, communication skills, and creativity with flexibility. These skills are essential to ensure employability, provide a competitive advantage, ensure future-ready careers, have cross-disciplinary applications, encourage entrepreneurship and leadership, facilitate professional networking, and enhance career advancement prospects (Michaela et Al, 2023).

According to Presidential Regulation No. 68 of 2022, Vocational High Schools are vocational education institutions established by the government, oriented towards meeting the needs of industry, the business world, and the workforce. The vocational high school curriculum is designed with a greater emphasis on practical and vocational aspects, enabling graduates to enter the workforce directly without requiring significant additional training. The integration of curriculum components into vocational education at vocational high schools plays a strategic role in preparing competent graduates who meet the demands of industry (Fadhillah et al., 2025). Furthermore, vocational high schools are expected to possess entrepreneurial competencies, enabling graduates to be both work-ready and entrepreneurial in line with industry needs. Although vocational high schools are designed to produce competent workers and entrepreneurs, in practice, this goal has not yet been fully achieved. The effectiveness of vocational high schools in addressing the challenges of technological disruption, which is drastically changing the industrial landscape, is currently unknown. According to (Mariah et al., 2025), intensive collaboration is needed, emphasizing the importance of clear communication, shared goals, and continuous evaluation of the results of partnerships between vocational education and industry to better prepare students for the evolving job market, ultimately contributing to economic growth and workforce development.

Technological developments such as artificial intelligence, the Internet of Things (IoT), big data, and automation are causing the industrial world to undergo significant changes. These changes create new demands for more adaptive, innovative, and technology-based workforce skills. However, many vocational high schools still face challenges in curriculum updates, outdated practical facilities, and limited teacher capacity in mastering the latest technologies. Educational institutions need to adopt a more holistic approach to skills development, ensuring that students are not only technically proficient but also proficient in communication, collaboration, and leadership, as well as skills that humanize the workplace in the era of automation and AI (Jaedun et al., 2024).

This study offers a critical analysis of the role of vocational high schools in preparing graduates capable of facing technological disruption, examining the inhibiting factors that prevent graduates from being well absorbed into the workforce. Beyond

simply highlighting shortcomings, this study also seeks to explore opportunities for improvement and strategic innovation that vocational high schools can adopt to be more responsive to technological developments. This critical approach differentiates it from previous studies, which tend to be descriptive and normative. By filling this knowledge gap, this research aims to provide conceptual and practical contributions to policymakers, vocational education providers, and the industrial sector, in building strategic synergies to enhance the competitiveness of the national workforce. The research findings are expected to serve as a reference in formulating vocational education policies that adapt to technological changes and future industrial needs.

Based on the background described above, the fundamental question to be addressed in this research is the role of vocational high schools in preparing graduates who are competitive in the era of technological disruption and the inhibiting factors.

B. Methods

This research uses a descriptive qualitative approach with a literature review method. This method can involve a comprehensive and systematic search of various databases, journals, and other information sources. The literature review was chosen to gain a deep understanding of the role of vocational high schools in preparing a competent workforce amidst the challenges of technological disruption. Furthermore, inhibiting factors and strategies needed to strengthen the relevance and contribution of vocational high schools to the development of superior and adaptive human resources will be examined. To this end, the researcher conducted a literature search and review of several scientific journals deemed relevant to the above issues using the ChatGPT AI platform, Google Scholar, and ResearchRabbit,



of published between 2021 and 2025. These journals were selected based on their relevance, currency, and contribution to explaining the relationship between vocational education and the dynamics workforce needs in the technological era. The criteria for selecting journals as samples were case studies on the successes and shortcomings of vocational high schools in several regions in Indonesia. The journals resulting from these case studies are expected to provide a snapshot of the real-world conditions of vocational high school education in Indonesia.

C. Results and Discussion

From the search process, fifteen journals relevant to the research theme were selected, with the keywords “The role of vocational schools in facing technological disruption,” “Factors inhibiting the relevance of vocational school graduates to industry and business,” and “Strategies for strengthening the role of vocational schools to be more adaptive and relevant to the needs of business and industry.”

Table 1. Research Classification Based on Similarity of Content Characteristics

| No | Title | Author | Research purposes | Research methods | Research result | Conclusion | Theme Group |
|----|---|----------------------------------|---|---------------------------------------|--|--|--|
| 1 | Hubungan Employability Skills dengan Kesiapan Kerja Siswa di SMK N 1 Sawit | (Anto et al., 2024) | To determine the influence of employability skills and digital literacy on the work readiness of state vocational school students in Central Jakarta. | Quantitative - Survey | Employability skills and digital literacy have a significant impact on work readiness. | Students’ job readiness is influenced by their work skills and digital literacy abilities. | Vocational High School Students’ Job Readiness |
| 2 | The Influence of Internship Experience and Employability Skills on the Job Readiness of Students at SMK Negeri 1 Banyudono | (Arifah Nur Hayati et al., 2024) | To determine the influence of internship experience and employability skills on students’ work readiness. | Quantitative - Simple random sampling | Both have a significant positive effect on work readiness. | Employability skills have a greater influence than PKL. | Vocational High School Students’ Job Readiness |
| 3 | The Influence of Career Planning and Employability Skills on the Job Readiness of Students at Kasiman State Vocational School | (Paramitha & Harmanto, 2024) | Analyzing the influence of career planning and employability skills on work readiness. | Qualitative - Case study | Both have an important influence on work readiness. | Career planning and employability skills improve job readiness. | Vocational High School Students’ Job Readiness |

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|---|---|-----------------------------|---|--|--|---|--|
| 4 | Mismatch between Education and Work is Not Always Detrimental | (Desvira & N, 2025) | Analyze the wage gap between workers who work in their field of expertise and those who do not. | Secondary data analysis - SAKERNAS 2024 | Mismatch does not always lower average wages, but creates gaps in wage distribution. | There is a need for a link and match policy for vocational schools and industry. | Relevance of Graduates, Business and Industrial World |
| 5 | Are Vocational School Students Ready to Face Workforce Disruption in The Construction Field? | (Arfandi et al., 2024) | Describes students' understanding of digital literacy and readiness to face technological disruption in the construction sector. | Quantitative - Descriptive | The majority of students already have high digital literacy and good work readiness, but there are still 18% of students who have not mastered digital literacy. | The percentage of students who have not mastered digital literacy is still quite high, so competency strengthening is needed. | Digital Competence of Vocational Teachers and Students |
| 6 | Improving Digital Security Skills for Students of SMK Ananda Bekasi in the Era of Digital Disruption | (Hidayat et al., 2024) | Assessing the relevance and readiness of the Independent Curriculum in shaping students' competencies in facing technological disruption. | Literature study and case study | The Independent Curriculum has the potential to improve 21st-century competencies. | Success depends on teacher readiness, infrastructure, and support. | Vocational High School Curriculum in the Era of Disruption |
| 7 | The Influence of Digital Literacy on Generation Z's Job Readiness in Vocational High Schools | (Putri & Supriansyah, 2021) | To find out whether digital literacy can influence the work readiness of generation z | Quantitative - Associative | The results of the analysis show that digital literacy has a positive and significant correlation with work readiness. | Digital literacy plays an important role in improving Generation Z's work readiness. | Vocational High School Students' Job Readiness |
| 8 | Job Readiness Training to Improve Career Adaptability for Vocational High School Students in Temanggung Regency | (Lasut et al., 2024) | To determine the effectiveness of job readiness training in improving career adaptability of vocational school | Quantitative - Experiment (pretest-posttest) | Effective training improves career adaptability. | Training interventions enhance career readiness and adaptability. | Vocational High School Students' Job Readiness |

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|----|---|-----------------------------|--|--------------------------|--|---|--|
| 9 | Matching the Competencies of Vocational School Graduates with the Needs of the Business and Industrial World | (Hidayati et al., 2021) | students. Assessing the relevance of SMK graduate competencies to the needs of DUDI. | Qualitative - Case study | Vocational school curriculum is relevant, but industry standards are higher. | There is a need to strengthen the curriculum and industrial partnerships. | Relevance of Graduates, Business and Industrial World |
| 10 | School Strategies in Increasing Competitiveness in the Era of Educational Competition: A Review from a Rational Choice Perspective Case Study at SMK Mulia Bakti Purwokerto | (Mahfud, 2023) | To examine the strategies implemented by SMK Mulia Bakti Purwokerto in increasing competitiveness amidst the tight competition in education, especially in the era of globalization. | Qualitative - Case study | The implementation of an industry-based curriculum, teaching factory, allocation of 70% of time for practicums, which has been proven to increase students' work readiness, increase the number of students and absorption of graduates by more than 80% into the workforce. | Industry-based curriculum, teaching factory, 70% practicum effectively increases job readiness, school competitiveness, and community interest. | Relevance of Graduates, Business and Industrial World |
| 11 | Unpacking the Digital Competence Challenge in Vocational Education | (Rahmawati et al., 2025) | Identifying the factors causing low digital competence of vocational teachers. | Qualitative - FGD | The digital competence of vocational school teachers is still low due to internal and external factors. | There is a need for continuous digital training for vocational teachers. | Digital Competence of Vocational Teachers and Students |
| 12 | Preparing Vocational Students for the Digital Economy | (Swaramarinda et al., 2025) | Analyzing the influence of digital literacy, agility, and digital entrepreneurship education on student readiness. | Quantitative - PLS-SEM | Digital literacy, agility, and digital entrepreneurship have a significant impact on student readiness. | The combination of these three aspects increases readiness to face the digital economy. | Vocational High School Students' Job Readiness |
| 13 | Vocational High School Curriculum in Facing | (Jaya et al., 2025) | Analyzing the vocational school | Literature review | The curriculum is not fully aligned with the | There is a need for an adaptive and | Vocational High School |

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|----|--|--------------------------|---|--------------------------|---|---|---|
| | the Era of Workforce Disruption | | curriculum in facing the era of disruption and industrial challenges. | | needs of DUDI. | collaborative curriculum. | Curriculum in the Era of Disruption |
| 14 | Collaboration between Vocational Education and Industry to Enhance Internship Competence | (Fitrianti et al., 2025) | Exploring collaboration between vocational schools and industry in student internship programs. | Qualitative - Case study | Effective collaboration improves curriculum relevance and student competency. | POAC-based school-industry collaboration effectively increases job readiness. | Relevance of Graduates, Business and Industrial World |
| 15 | Unlocking Workforce Readiness through Digital Employability Skills | (Kholifah et al., 2025) | Analyzing the employability skills of vocational graduates based on human capital and digitalization. | Quantitative - PLS-SEM | Digital communication and collaboration are key mediators of work readiness. | Digital soft skills are important for job readiness in the Industry 4.0 era. | Vocational High School Students' Job Readiness |

Based on the search results related to the role of vocational schools in facing the era of technological disruption, 15 journals were grouped based on similarities in research content characteristics, resulting in 4 large groups being found, which are displayed in the following table.

Table 2. Journal Groups Based on Similarity of Research Content Characteristics

| Group | Main Focus/Subject | General Research Objectives | List of Research Titles (No.) | Characteristics/Red Thread |
|--|--|---|-------------------------------|--|
| Vocational High School Students' Work Readiness and Influencing Factors | Vocational high school students (various majors) | Measuring the influence of employability skills, digital literacy, career planning, internship experience, or training on job readiness | 1, 2, 3, 7, 8, 12, 15 | Focus on the relationship between student competency variables (soft skills, digital literacy, critical thinking, entrepreneurial agility, training) and work readiness. |
| Relevance of Vocational High School Graduate Competencies to the Business and Industrial World . | Vocational school graduates and industry needs | Assessing the suitability of graduate competencies, certifications and competitiveness to industry needs | 4, 9, 10, 14 | The research highlights the importance of school-industry partnerships, competency gaps, and the effectiveness of Business and Industrial World collaboration. |
| Challenges and Strengthening of Vocational High School Curriculum in the Era of Technological Disruption | Vocational High School System/Curriculum | Evaluating curriculum readiness to face the Industry 4.0 era and digital disruption | 6, 13 | The research consists of a literature review and analysis of vocational education policies. |
| Digital Competence in Vocational Education (Teachers and Students) | Vocational school teachers and vocational students | Identifying factors that influence digital competence and their implications for vocational learning | 5, 11 | Focus on digital literacy levels, readiness to face technological disruption, and factors causing low digital competence of vocational teachers. |

Vocational High School Students' Employment Readiness and Influencing Factors

The results of this study indicate that vocational high school students' work readiness is influenced by a combination of key competencies, including employability skills, practical work experience, career planning, digital literacy, and psychological aspects such as career adaptability. The dominance of employability skills appears consistent across most studies, although the magnitude of the resulting effect varies across regions, majors, and educational institution characteristics. This variation can be explained by differences in the methodologies used, ranging from quantitative surveys and qualitative case studies to experiments and PLS-SEM analysis, which provide varying levels of analytical depth and sample diversity. Furthermore, the different focus of research variables contributes to the differences in findings, such as the greater influence of digital literacy in technology-oriented schools and the dominant role of career planning and practical experience in technical vocational schools. Nevertheless, the general pattern suggests that work readiness is the result of an interaction between technical competencies, soft skills, and the ability to adapt to changes in the world of work.

Cross-study findings consistently confirm that soft skills are the main predictor of vocational high school students' work readiness in the context of technological disruption. Communication skills, collaboration, discipline, responsibility, and adaptability have been shown to have a significant correlation with employability and readiness to work, thus reinforcing the view that work readiness is not only determined by mastery of technical competencies, but also interpersonal and intrapersonal skills relevant to the needs of modern industry (Jaedun et al., 2024). Several studies even show that weaknesses in soft skills are often a major obstacle in the absorption of graduates into the industrial world, considering that the current world of work demands the ability to adapt quickly, work across functions, and collaborate in teams. Thus, strengthening soft skills is a strategic aspect in the development of a competency-based vocational curriculum.

Furthermore, digital literacy has emerged as a crucial component in expanding the technical and non-technical capabilities of vocational high school students in the Industry 4.0 era. Digital literacy not only improves work efficiency but also fosters creativity, innovation, and the ability to interact within the digital ecosystem. This is in line with what (Caroline et al., 2024) stated, emphasizing that digital literacy has become a core component of employability, especially in an increasingly digitalized work environment. Therefore, the integration of digital learning through simulations, digital project-based learning, and online collaborative platforms needs to be strengthened in vocational programs to improve students' readiness to enter the digital industry.

Another crucial factor is critical thinking skills. These skills enable students to solve complex problems, conduct rational analysis, and generate innovative solutions in professional contexts. Research (Felipe et al., 2023) shows that implementing learning strategies such as problem-based learning, case studies, and industrial simulations significantly improves vocational students' critical thinking skills, which directly impacts their job readiness. This indicates the importance of systematically integrating pedagogical strategies that stimulate higher-order thinking skills into the learning process in vocational schools.

From a broader perspective, entrepreneurial agility is also a crucial aspect that enriches the concept of work readiness, particularly in the context of the digital economy. The ability to adapt, innovate, and exploit business opportunities not only prepares students for work but also prepares them to create new jobs. Furthermore, (Mack et al., 2024) emphasized that experiential entrepreneurship education, such as digital business projects, entrepreneurial incubations, and startup competitions, can enhance students' entrepreneurial orientation and career resilience. Therefore, strengthening agility-based entrepreneurship modules is a crucial strategy in preparing competitive and independent vocational graduates.

Furthermore, practical training such as Field Work Practices, structured internships, and industry-based training serve as important mediators that strengthen the relationship between student competency and job readiness. Research (Azizah et al., 2021) shows that real-world practical experience not only improves technical competency but also strengthens soft skills, enriches digital literacy, and fosters a professional work ethic required by industry. Similarly, (Prabowo et al., 2023) confirm that structured work skills programs contribute significantly to improving the job readiness of vocational students. Therefore, synergy between the school curriculum and industry needs in designing relevant Field Work Practices programs is a critical factor in producing graduates who are adaptive, competent, and ready to face the dynamics of the modern labor market.

Relevance of Vocational High School Graduate Competencies to the World of Business and Industry

The synthesis of various studies shows that the work readiness of vocational high school graduates is the result of a complex interaction between curriculum suitability, industry-based practical experience, and the intensity of collaboration between educational institutions and the business and industrial world. Studies at SMK Mulia Bakti Purwokerto and SMK Negeri 8 Samarinda confirmed that learning innovation, adequate allocation of practical time, and the implementation of dual evaluation between school and industry contribute significantly to improving student competency and work readiness. However, research at SMK N 1 Batang still found a mismatch between school competency standards and industry needs, so that

not all graduates are able to enter the work field according to their specialization. This variation in findings is mainly influenced by differences in regional context, focus of expertise, research methodology, and the level of school innovation in implementing industrial practices and collaborative strategies with work partners. Nevertheless, all studies consistently conclude that the work readiness of vocational high school graduates is largely determined by the integration of relevant curriculum, quality practical experience, and active and sustainable collaboration patterns with industry.

Cross-research findings also confirm a significant skills mismatch between the competencies of vocational high school graduates and the actual demands of the industrial and industrial sectors. Although graduates generally possess sufficient basic technical competencies to occupy entry-level positions, various studies indicate that there are still deficiencies in non-technical aspects such as communication skills, teamwork, discipline, and mastery of the latest technical specifications (Rikala et al., 2024). This condition impacts the low rate of optimal employment of vocational high school graduates. In response to this issue, the government continues to strengthen the implementation of the link and match policy through the 8+i program, which requires industry involvement in the entire vocational education process, from curriculum development and provision of industry instructors, internships, development of learning materials, to character development and student work culture (Syauqi et al., 2022).

Furthermore, the relevance of vocational high school graduate competencies is greatly influenced by the ability of vocational institutions to adapt to the dynamics of industry needs. Various studies emphasize the importance of curriculum adjustments, building industry-academia partnerships, and sustainable skills improvement programs to reduce this competency gap (Alam et al., 2025). Strong partnerships are known to improve the quality of vocational training through curriculum alignment, utilization of industry resources, and provision of internship and job placement opportunities (Mariah et al., 2025). Another study showed that schools that establish long-term and sustainable relationships with industry partners are better able to adapt teaching materials, practical tools, and evaluation mechanisms quickly to changing labor market needs, while incidental partnerships do not significantly impact the quality of outcomes (Suyetno et al., 2024).

In addition to partnerships, the effectiveness of Field Work Practices and industry-based training is also determined by the quality of program design, implementation, and evaluation. According to (Kiram et al., 2025), the effectiveness of Field Work Practices is greatly influenced by the accuracy of industry partner selection, the competence of mentors, the relevance of the practical curriculum, and the existence of a structured feedback mechanism. Field Work Practices that have measurable assessment indicators and a joint monitoring system has been proven to significantly

increase student readiness to work. Based on these findings, the work readiness of vocational high school graduates can be concluded to be greatly influenced by three main factors: (1) the suitability of technical competencies to industrial technology developments, (2) strengthening soft skills and adaptive abilities through a context-based curriculum, and (3) the effectiveness of school-industry partnerships oriented to labor market needs.

Challenges and Strengthening of Vocational High School Curriculums in the Era of Technological Disruption

The analysis shows that both studies affirm the importance of strengthening vocational high school curricula to address technological disruption, although they highlight different aspects. The first study emphasizes the need to integrate digital competencies, particularly digital literacy and security, into the curriculum, as this has been shown to improve students' readiness for technological change. Conversely, the second study highlights the curriculum's low relevance to the needs of the industrial and industrial sectors as a contributing factor to graduates' unpreparedness, making more adaptive curriculum reform urgent. These two findings complement each other, suggesting that graduate readiness can only be achieved through a combination of strengthening digital competencies and aligning the curriculum with industry dynamics.

More broadly, rapid technological changes, including automation, the Internet of Things (IoT), artificial intelligence (AI), and immersive technologies like mixed/extended reality, have raised the competency standards required for vocational high school graduates. Employability is no longer solely driven by technical skills, but also requires analytical skills, digital literacy, and collaborative capabilities. However, recent research indicates that the readiness of vocational institutions remains moderate, with a significant gap between formal curricula and the needs of digital technology-based industries (Liza Maria Lee, 2024). This indicates a skills mismatch that has not been fully addressed through the current curriculum approach.

The Independent Curriculum was designed to respond to these changes by strengthening 21st-century competencies, project-based learning, and flexibility in adapting teaching materials. However, the effectiveness of its implementation is greatly influenced by teacher readiness, the availability of digital resources, and school managerial support. According to (Saiman et al., 2025), limited facilities and suboptimal teacher adaptation processes are the main obstacles to the implementation of this curriculum. These findings are reinforced by (Riyanda et al., 2025) and (Ben Gurion & Nasir, 2024), who highlight disparities in facilities between vocational schools and variations in teacher pedagogical competencies. Learning Management System (LMS) and immersive technology-based interventions do have

the potential to improve teacher and student competency, but their effectiveness depends on contextual training and ongoing technical support.

Immersive technologies such as mixed reality have been shown to improve student work readiness, but their implementation requires long-term infrastructure investment and regulatory support. Recent literature recommends four strategic policies: (1) curriculum updates that align with industry needs, (2) ongoing teacher training based on industry experience, (3) prioritizing funding for strengthening schools' digital infrastructure, and (4) providing incentives for partner industries participating in vocational programs (Liza Maria Lee, 2024). Furthermore, the success of vocational reform relies heavily on micro-credential-based evaluations and evidence-based portfolios as the basis for monitoring student achievement ((Rikala et al., 2024). Therefore, synergistic collaboration between schools, industry, government, and technology providers is a key prerequisite for realizing a sustainable and adaptive vocational education ecosystem in the digital era.

Digital Competence in Vocational Education for Teachers and Students

The results of the study indicate that the findings of both studies are not entirely consistent, particularly regarding digital readiness in vocational education. The first study, which focused on vocational high school students in the construction and property sector, found that their digital literacy understanding and readiness to face technological disruption were in the very good category, indicating students' readiness to meet industry needs. However, the second study, which examined the digital competence of vocational educators, yielded conflicting findings, namely low teacher digital competence, influenced by limited infrastructure, minimal training, time constraints, and personal factors such as low self-confidence and intergenerational gaps.

These discrepancies in findings were primarily due to differences in the unit of analysis (students versus teachers), methodologies (quantitative surveys versus qualitative focus group discussions), and variations in institutional conditions on the ground. These conditions indicate that although students appear to be more digitally prepared, this readiness is not fully supported by educator competence. Therefore, low teacher digital competence has the potential to be a major obstacle to ensuring the sustainability and quality of technology-based learning in vocational education.

This analysis aligns with the findings of international studies. Research (Ji Xia Wu, 2025) confirms that the digital competence of vocational teachers globally remains at a moderate to low level and is not yet supported by a comprehensive standards framework. Furthermore, (Althubyani, 2024) identified four main determinants of teachers' digital competence: infrastructure availability, access to ongoing training, teacher personal characteristics such as age and experience, and exposure to

industry practices. Disparities between educational institutions also exacerbate the digital divide; schools with high accreditation and strong managerial support have been shown to have better digital readiness than schools in disadvantaged areas (Mulyanti et al., 2024).

Several intervention strategies have been recommended to address these challenges. This is in line with (Rahmawati et al., 2025), who emphasized the importance of improving teachers' digital literacy through technology-based training, online courses, and strengthening their ability to integrate digital learning media. School policy support, including the provision of facilities and empowerment of teacher learning communities, is also a crucial determinant of the success of digital transformation in vocational schools. Furthermore, (Domínguez-gonzález, 2025) proposed an integrated strategy that includes increasing infrastructure investment, providing industry-based teacher training, and establishing a credible digital competency accreditation mechanism. Implementation of this strategy will be more effective when combined with co-teaching, teaching factory, or dual-system training models to ensure a direct link between learning and industry needs.

Furthermore, (Vasilev, 2024) highlighted the role of micro-credentials as a strategic instrument in validating and recognizing digital skills, especially for students and low-qualified workers. Micro-credentials designed to meet industry needs and student aspirations have the potential to bridge the gap between vocational education and the labor market, while ensuring competency relevance in the era of technological disruption. Overall, this analysis confirms that improving digital competencies in both students and teachers is a crucial prerequisite for realizing vocational education that is adaptive, inclusive, and responsive to technological dynamics.

Overall, the results of these studies demonstrate that the Indonesian vocational education system has clearly identified determinants of student work readiness, including employability skills, practical experience, digital literacy, and curriculum relevance. However, these findings do not fully describe how these factors can be effectively implemented in diverse school contexts. In other words, most studies primarily describe what needs to be strengthened, but fail to demonstrate how this strengthening can be realized through learning strategies, teacher training mechanisms, or standardized industry partnership designs.

In this context, the issue of teacher digital competency and adaptive curriculum is a critical issue. Low digital competency among educators has the potential to hinder the adoption of technology-based learning, while a curriculum that is not adaptive to industry dynamics results in low graduate competency relevance. Alignment between the two is a key prerequisite for improving graduate quality, as technology-based vocational transformation can only occur when teachers possess adequate

digital skills and the curriculum is able to respond quickly and measurably to industry changes.

Based on these findings, the Integrated Vocational Readiness Model (IVRM) is proposed as a conceptual framework to clarify the relationships between variables. This model illustrates that teacher digital competency serves as the foundation for learning transformation, an adaptive curriculum serves as a mechanism for education-industry alignment, graduate competency relevance acts as a key mediator, and work readiness emerges as the end result of the interaction of all components. This approach offers a new direction for research and policy, shifting from a focus on identifying factors to designing effective and measurable implementation mechanisms in vocational education practices.

D. Conclusions

This study confirms that Vocational High Schools have a strategic role in preparing competent, adaptive, and responsive human resources to the demands of the Industrial Revolution 4.0 and the transition to Society 5.0. Graduates' job readiness is shaped by the integration of technical competencies, employability skills, digital literacy, critical thinking skills, industrial practice experience, and psychological aspects such as career adaptability, with soft skills consistently being the most influential factor. However, the relevance of vocational high school graduates still faces obstacles, including a mismatch of competencies with the needs of the business and industrial world, curriculum implementation that is not yet adaptive to technological developments, low teacher digital readiness, and industry partnerships that tend to be sporadic and unsustainable. These findings emphasize the importance of curriculum synchronization, strengthening teachers' pedagogical and digital competencies, optimizing the implementation of fieldwork practices, and expanding strategic collaborations with industry. This study enriches theoretical studies on the importance of industry-based learning, the integration of cutting-edge learning technologies, and the use of micro-credentials as flexible and standardized assessments. However, this study has limitations, namely the study period 2021–2025, the potential for selection bias, and the geographic focus on the Indonesian context. Therefore, further research is recommended to test the effectiveness of the IVRM Model with mixed methods, evaluate the use of micro-credentials in various skill programs, and conduct longitudinal studies to assess the long-term impact of teaching factories and industry partnerships on graduates' work readiness.

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