Integrating School Facilities and Teaching Quality to Improve Employability Skills in the Machining Engineering Expertise Program

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DOI: https://dx.doi.org/10.47772/IJRISS.2025.909000290

Received: 30 August 2025; Accepted: 04 September 2025; Published: 09 October 2025

ABSTRACT

This study examines the integrative influence of school facilities and teaching quality on the employability skills of vocational high school students in the Machining Engineering Expertise Program. Employing a quantitative ex post facto approach, the study involved 167 students from two public vocational schools in Yogyakarta, Indonesia, who had completed an industrial work practice program. Data were analyzed using the Partial Least Squares-Structural Equation Modeling (PLS-SEM) method. The results showed that school facilities had a significant effect ($\beta = 0.417$; $p < 0.05$), and teaching quality based on the Technological Pedagogical Content Knowledge (TPACK) framework also had a significant effect ($\beta = 0.435$; $p < 0.05$) on enhancing employability skills, with a combined contribution of 60.7%. These significant effects underscore the importance and impact of the synergy between infrastructure and pedagogical approaches in preparing students to meet the demands of industry. Practical implications include optimizing practice facilities, providing TPACK-based teacher training, and aligning vocational education policies to support effective learning. This study provides empirical contributions to the development of an integrative model in technical vocational education.

Keywords: Employability Skills, School Facilities, Teaching Quality, TPACK, Vocational Education.

INTRODUCTION

The rapid development of the 4.0 industrial revolution has transformed the landscape of labor needs, requiring vocational education graduates not only to possess technical competencies but also to be equipped with various employability skills. These skills include communication, critical thinking, adaptability, problem-solving, teamwork, and independent learning. In response to these dynamics, vocational education institutions, particularly Vocational High Schools (VHS), are required to prepare students to compete in an increasingly competitive and dynamic job market.

Despite various policies and curriculum reforms, VHS graduates in Indonesia still dominate the national unemployment rate. According to data from the Central Statistics Agency (CSA) in 2022, the open unemployment rate for VHS graduates reached 9.42%, the highest among other secondary education levels. This indicates a gap between the competencies acquired during school and the expectations of the industrial world. This situation is particularly pronounced in the Mechanical Engineering program, where technological advancements require proficiency in both conventional machinery and cutting-edge technologies, such as CNC machines and computer-based systems. Unfortunately, limited practical facilities and varying teaching quality pose obstacles for students in developing skills relevant to the industrial world.

School facilities and teaching quality play a strategic role in shaping employability skills. The availability of adequate infrastructure, including practical laboratories, workshops, CNC machines, and technology-based learning tools, helps students gain learning experiences that closely resemble real-world industrial practices.

Meanwhile, the quality of teaching, particularly that based on the Technological Pedagogical Content Knowledge (TPACK) approach, ensures that the learning process is contextual, meaningful, and aligned with the needs of the workplace.

Although these factors, school facilities and teaching quality, have been extensively discussed separately in various studies, there has been little empirical research examining their integrated influence. However, a comprehensive understanding of how school facilities and teaching quality collectively impact students' work skills is crucial for designing policies and strategies to strengthen learning in vocational schools. This situation highlights an important research gap that needs to be addressed, particularly in the context of the Mechanical Engineering program, which demands a high degree of alignment between school-based learning and industrial practice.

Based on this background, this study aims to analyze how the integration of school facilities and teaching quality can contribute to improving the employability skills of vocational high school students in the Machining Technology program in the Yogyakarta area. This study is expected to make empirical contributions to the development of vocational education policies that align with current industry demands, as well as provide practical recommendations to strengthen school strategies in preparing graduates who are ready for work.

Employability Skills in Vocational Education

Employability skills, as a versatile set of skills, are not only necessary to obtain, maintain, and develop in the workplace, but also applicable in various types of work. These generic skills, as Munadi et al. (2018, p. 41) note, are a prerequisite for entering the workforce. Thapa (2024) further emphasizes that these skills, often referred to as work skills, are a set of abilities that employers consider essential for new graduates to perform their duties optimally in the workplace.

According to Tisa et al. (2024), employability skills, including effective communication, teamwork, leadership, and adaptability, are essential for the workplace. Fidiah et al. (2022) further note that these skills also encompass problem-solving, initiative, self-management, utilizing technology and information, and applying occupational safety and health (OSH) principles. These competencies, when honed, play a crucial role in enhancing productivity, efficiency, and the quality of work among vocational school students in a dynamic and competitive industrial environment.

In the context of vocational education, particularly in the Machining Technology program, employability skills are not only critical but also indispensable. Students in this program are not only required to master technical aspects, such as operating lathes or CNC machines, but also to work collaboratively, solve problems in real-world environments, and adapt to technological changes. Graduates of the Machining Technology program who possess strong employability skills will be better prepared to face the challenges of the industrial world and have a higher competitive edge in the job market.

School Facilities and Their Impact on Learning

The role of school facilities in vocational education is paramount. These facilities encompass a range of physical components and resources that underpin the practical learning process. They include laboratories, workshops, well-equipped classrooms, practical tools, and access to technology and information. As Arifin & Rahman (2022) assert, the quality and availability of these learning facilities have a profound impact on student competencies, particularly in vocational education that emphasizes hands-on practice.

School facilities are not just tools for learning, but also catalysts for developing employability skills. Learning in an environment with quality facilities can significantly enhance vocational training and prepare students to meet the dynamic demands of modern industry. The quality of school facilities is directly linked to the quality of graduates and the relevance of their skills to the labor market, as affirmed by Hasbullah et al. (2022), underscoring the strategic role of vocational school facilities in shaping students' work skills.

Quality facilities provide students with authentic learning experiences that closely mirror real work situations.

Conversely, inadequate facilities can impede the acquisition of technical skills, diminish the effectiveness of learning, and lead to low work readiness among graduates. Therefore, the imperative of investing in school facilities to support the development of students' work skills cannot be overstated.

Teaching Quality in Vocational Education

Teaching quality is a crucial factor in the success of vocational schools. It encompasses teachers' pedagogical competence, mastery of learning content, and their ability to integrate technology into the teaching process. One widely used approach to measure technology-based teaching quality is the Technological Pedagogical Content Knowledge (TPACK) framework, developed by Mishra and Koehler in 2006. TPACK is a unique form of knowledge that goes beyond the traditional boundaries of pedagogy, content, and technology in education. It emphasizes the need to balance these three knowledge areas to create effective learning environments.

TPACK is a form of knowledge that transcends the conventional boundaries of the three main components in education, namely pedagogy, content, and technology. TPACK emphasizes the importance of balancing content, pedagogical, and technological knowledge to create effective learning. In the context of vocational education, teachers who are competent in TPACK can design technology-based learning that is more relevant, engaging, and interactive. For instance, they can use virtual simulations to teach practical skills or online resources to supplement traditional learning materials. This enhances student motivation and accelerates the achievement of competencies, including work skills.

Research indicates that teaching is reflected through the creation of a supportive and inclusive school environment, the development of strong relationships with students, and teachers' confidence in their own competencies (Zajda, 2023). This highlights the pivotal role of teachers in shaping the learning environment and underscores the importance of their ongoing professional development. A teaching quality approach that involves technology integration is becoming increasingly important, offering an optimistic outlook for the future of vocational education by improving students' skills relevant to the needs of the workforce in this digital technology era.

Conceptual Model

Building on theoretical reviews and previous findings, this study has developed a conceptual model that elucidates the complex relationship between school facilities and teaching quality, as independent variables, and students' employability skills, as dependent variables. This model highlights the crucial role of adequate learning facilities and high-quality TPACK-based teaching in enhancing students' employability skills, underscoring the importance of this study.

The following is the conceptual model of this study:

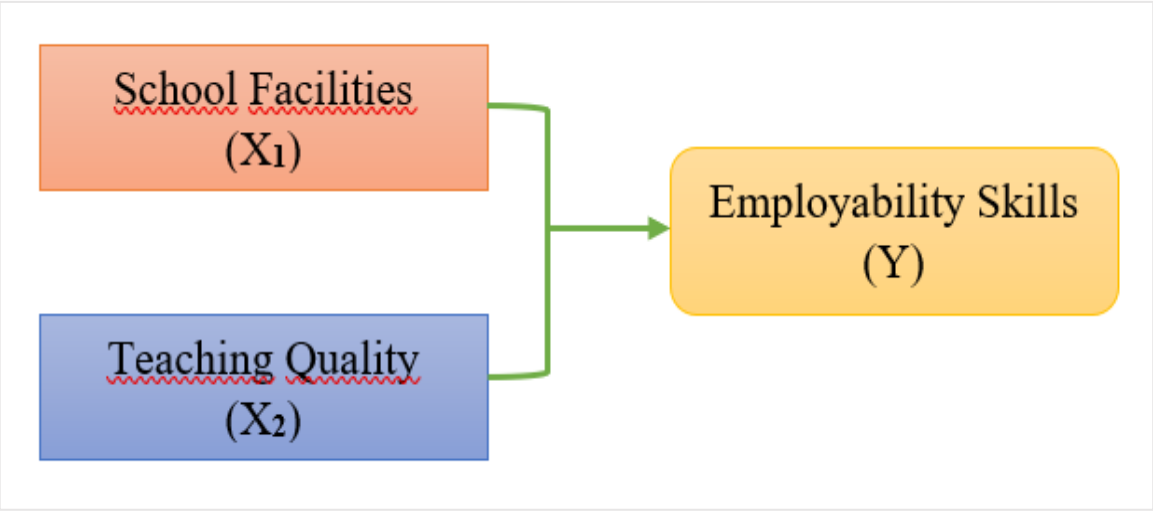

Fig. 1 Conceptual Model

This model served as the foundation for a rigorous data analysis, employing the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach with the assistance of SmartPLS software. The meticulousness of this analysis ensures the robustness of our findings.

This model proposes two main hypotheses:

1. H1: School facilities have a positive effect on students' employability skills.
2. H2: Teaching quality has a positive effect on students' employability skills.

Reasons for the Current Study

While the importance of employability skills in vocational education has been widely recognised (Suarta et al., 2020; Zajda, 2023), the integration of these skills through contextual approaches such as providing adequate school facilities and improving teaching quality has been relatively under-researched, particularly in the context of vocational schools in Indonesia. This gap is urgent, given the high open unemployment rate among VHS graduates, which reflects a significant mismatch between the competencies acquired in school and the demands of the job market (CSA, 2022).

Employability skills are essential for bridging the transition from education to the workforce, especially in technical programs like Mechanical Engineering, which require mastery of technical competencies as well as soft skills such as adaptability, problem-solving, communication, and digital literacy. In this context, the role of school infrastructure and the quality of learning become vital. However, empirical studies examining the influence of combining these two educational aspects on students' work skills remain limited in Indonesia.

Furthermore, the primary challenge faced by vocational high school students in the field of machining technology is aligning theoretical and practical learning with the ever-evolving needs of the industry. Facilities such as CNC machines, practical laboratories, and access to digital devices are indeed necessary, but they are not sufficient on their own. The effective utilisation of these facilities through teaching strategies based on the TPACK approach is crucial in determining students' learning outcomes.

Therefore, this research is of utmost importance to fill the knowledge gap on how the integration of school facilities and teaching quality contributes to the development of students' employability skills in the Machining Technology program. This study is not only relevant in terms of timing and context, but it is also expected to serve as a crucial basis for vocational education policy direction in Indonesia, strategically targeting the creation of SMK graduates who are ready for the workforce and thereby significantly impacting the future of vocational education in the country.

Context of Employability Skills Development in Vocational Education in Indonesia

The Technical and Vocational Education and Training (TVET) sector in Indonesia is undergoing a transformation process, characterised by specific changes, in response to globalisation, technological disruption, and national efforts to reduce youth unemployment. Vocational schools, as the backbone of vocational education, still face challenges in resource allocation, curriculum responsiveness, and teacher competence.

1. Labour market challenges: VHS graduates continue to face high unemployment rates (CSA, 2022). The industrial world often reports gaps in work readiness, such as specific examples particularly in terms of soft skills and digital literacy.
2. Infrastructure disparities, which significantly limit the effectiveness of practical learning, are a pressing issue that needs to be addressed.
3. Teacher pedagogical readiness: Many VHS teachers have not fully adopted integrated teaching approaches such as TPACK, which impacts the effectiveness of teaching relevant to industry needs.

These factors make the development of strategies to effectively build employability skills increasingly urgent across the vocational education system.

Justification for Research

Based on considerations of the context of vocational education development, there is strong justification for conducting research that examines the integrative influence of school facilities and teaching quality on the development of employability skills. This research is important for the following reasons:

1. Addressing empirical gaps: Previous studies have not comprehensively examined the combined impact of educational infrastructure and teacher quality in the context of vocational schools, particularly in the field of Mechanical Engineering.
2. Enhancing vocational relevance: This research contributes to efforts to align vocational education programs with the evolving needs of the labour market.
3. Supporting educational practices and policies: the research results can be used as a basis for developing strategies to improve the quality of education in schools, including resource allocation, teacher training, and TPACK-based learning design.
4. Promoting national educational achievements: As Indonesia strives to strengthen its vocational education sector as part of national development, data-based evidence is needed to guide investment in educational facilities and teaching quality.

This study is expected to enrich the literature and provide a model for integrating the key factors that shape the employability skills of vocational high school students. It will also offer significant implications for curriculum development, school management, and the direction of vocational education policy, highlighting our shared responsibility and commitment to guiding investment in educational facilities.

METHODOLOGY

Research Design

This study employs a quantitative approach with an ex post facto type that is associative causal. The purpose of this design is to accurately determine the relationship and influence between two independent variables—school facilities and teaching quality—on the dependent variable, namely, students' work skills. This approach was chosen because the researchers did not directly manipulate the variables but rather observed phenomena that had already occurred, ensuring the objectivity and impartiality of the study. This emphasis on objectivity should instill confidence in the research findings.

Research Location and Subjects

This research was conducted at two state vocational high schools in Yogyakarta City, SMKN 2 Yogyakarta and SMKN 3 Yogyakarta, which offer a Mechanical Engineering study program. The selection of these locations was a carefully planned process, taking into account their adequate practical facilities and consistent implementation of industrial internship programs. This careful selection ensures the relevance and applicability of the research findings, instilling confidence in the research's validity.

The subjects of this study were Grade XII Machining Engineering students who had participated in industrial internship activities. The population consisted of 253 students, with a sample size of 167 students carefully selected using proportional random sampling, ensuring a representative group for the study.

Data Collection

Data was collected with great care using a closed questionnaire/survey with a 4-point Likert scale. This questionnaire was meticulously designed to measure students' perceptions of the availability of school facilities, the quality of teaching they received, and the level of employability skills they felt they had acquired after participating in industrial work placements, ensuring the accuracy and reliability of the study's findings.

The data instrument was previously tested for content validity through expert judgment, followed by statistical validity and reliability testing. The results of the first outer loading analysis revealed that three indicators did not

meet the factor loading criteria: two indicators from school facilities and one indicator from employability skills. A second outer loading analysis was then conducted, the results of which showed that the instrument met the validity criteria and had a Cronbach's Alpha value > 0.7 (Ghozali & Latan, 2015, pp. 76-81), indicating high reliability.

Data Analysis

The data obtained were analysed descriptively using Microsoft Excel 2021 and Structural Equation Modelling–Partial Least Squares (SEM–PLS) analysis with the help of the SmartPLS 3.0 application. SEM–PLS was chosen because it is capable of analysing causal relationships between latent variables simultaneously and is suitable for non-normal data and relatively moderate sample sizes. The analysis steps included: (1) testing the measurement model (outer model), (2) testing the structural model (inner model), and (3) testing the hypothesis.

RESULTS AND DISCUSSION

Findings Related to School Facilities

The descriptive analysis results demonstrate that the high level of achievement of school facilities, with average indicator scores ranging from 2.778 to 3.150 and a total average score of 45.371. The availability of supporting facilities and infrastructure, such as laboratories, practice rooms, and access to technology, at SMKN 2 and SMKN 3 Yogyakarta not only enables students to practice optimally but also enhances their contextual experience. Figure 2 illustrates the graph of the average indicator values for the school facilities variable, showcasing the positive impact of these resources on students' employability skills.

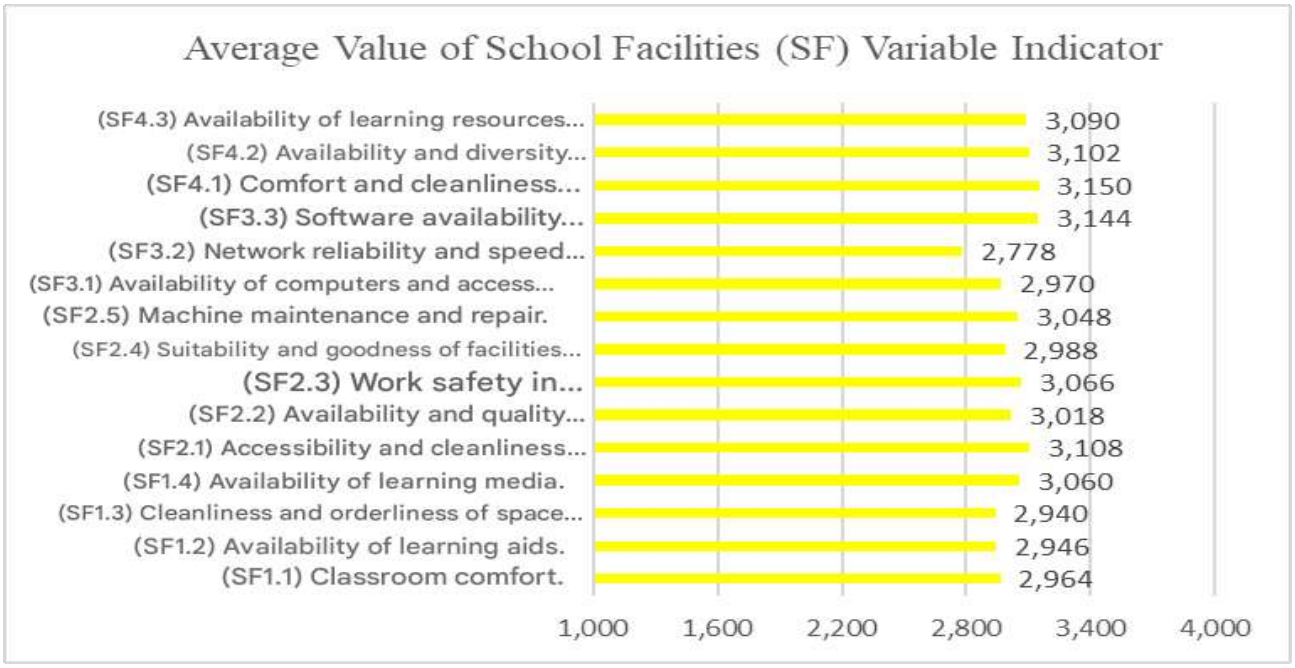

Fig. 2 Average Value of Each School Facilities Variable Indicator

Furthermore, the SEM–PLS test results indicate that school facilities have a positive and significant effect on students' employability skills, with a T-statistic value of 3.583 (T*table* > 1.962), a path coefficient value of 0.417 or 41.7%, and a p-value < 0.05. This indicates that the better the facilities available and used optimally, the higher the level of employability skills perceived by students, particularly in technical practical skills, technological adaptation, and the application of industry standards in the learning environment.

Findings Related to Teaching Quality

Students' perceptions of the level of achievement in teaching quality factors, based on descriptive analysis results, were also in the high category, with average indicator scores ranging from 3.084 to 3.210 and a total

average score of 47.036. This indicates that teaching that integrates technology, pedagogy, and content strengthens students' critical thinking, problem-solving, and collaboration skills. Figure 3 illustrates the average indicator scores for teaching quality variables.

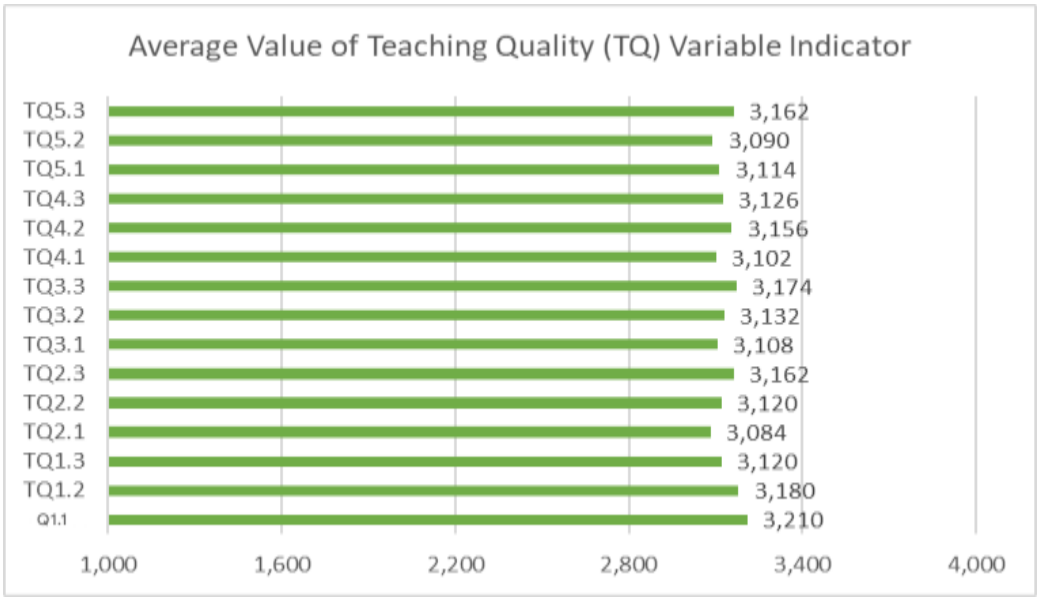

Fig. 3 Average Value of Each Indicator of Teaching Quality Variable

Based on the results of the SEM-PLS structural analysis, teaching quality has a positive and significant effect on students' employability skills, with a T-statistic value of 3.728 (T-table > 1.962), a path coefficient value of 0.435, and a p-value < 0.05. This reinforces the finding that instructional quality not only influences academic achievement but also facilitates the development of essential soft skills, such as critical thinking, communication, and teamwork, which are highly relevant to the workplace.

Integrated Approach and Synergy

The findings of this study underscore the importance of an integrated approach, where school facilities and teaching quality are considered in tandem. This approach has a greater impact on improving students' employability skills than if the two were considered separately. The R-squared results indicate that the two variables together explain 60.7% of the variability in students' employability skills, demonstrating the strong predictive power of the synergy between the two. This should inspire educators and policymakers to adopt a comprehensive strategy in their educational institutions, thereby enhancing the employability of their students.

Comparison with Previous Studies

These findings support the view that the availability of adequate facilities and infrastructure, such as practice rooms, laboratories, technological devices, and industrial equipment, provides a learning experience that closely resembles real-world work situations. This enables students to master technical skills through hands-on practice with the latest equipment, develop creativity in solving real-world problems, and adapt to the work environment through industrial condition simulations. This is also consistent with the resource-based view theory (Barney, 1991), which emphasises that the availability of adequate physical resources is a key factor in competency development. The results of this study are also in line with the findings of Arifin and Rahman (2022), who emphasise the importance of practice facilities as a determining factor in the success of vocational learning.

Moreover, the Technological Pedagogical Content Knowledge (TPACK) teaching approach is of paramount importance, particularly in the era of AI. It equips educators with the ability to seamlessly integrate content, pedagogy, and technology. When teachers adeptly employ adaptive learning strategies, such as work practice simulations, project-based learning, or interactive digital media, students are better positioned to develop collaborative skills, problem-solving abilities, and critical thinking, which are crucial for employability. The role of the TPACK approach in enhancing the work competencies of vocational students is underscored by

Willermark's (2021) study and further corroborated by Scherer et al.'s (2023) analysis, which underscores the importance of contextualising TPACK with industry needs. However, in the era of AI, the integration of generative technology literacy, as underscored by Mishra and Warr (2021), becomes a critical factor in preparing students for future jobs.

However, the true uniqueness and novelty of this article lie in its integrative approach to two important aspects of vocational education: facilities and teaching quality. This approach, which has not been widely discussed in the context of Vocational high schools for mechanical engineering in Indonesia, makes a significant contribution to the existing literature. By offering a new perspective, this article demonstrates the value and importance of optimising vocational education strategies more comprehensively.

CONCLUSION

In conclusion, this study underscores the crucial role of school facilities and teaching quality in shaping and enhancing the employability skills of vocational high school students, particularly those in the Machining Engineering program in Yogyakarta City. The main findings indicate that the integration of school facilities and the quality of teaching significantly contribute to improving the employability skills of students in this program. Both factors demonstrate high individual achievement levels and exert a positive and substantial influence on students' employability skills.

The study's findings have significant practical implications for vocational high schools. It underscores the importance of providing adequate school facilities, such as practical laboratories, production machinery, and access to technology, to support the development of technical skills and learning experiences that mirror the industrial world. Moreover, it highlights the value of teaching quality that integrates pedagogical approaches, content, and technology (TPACK) in strengthening students' non-technical skills. The simultaneous integration of both factors is shown to have a more pronounced influence on employability skills than when they are implemented in isolation.

Practical Implications

These findings have important practical implications:

1. For schools, there is a need to optimize and maintain practical facilities to support industry-based learning.
2. For teachers, the improvement of TPACK-based pedagogical capacity must continue to be facilitated so that teaching is more contextual and adaptive to technology.
3. For policymakers, the results of this study can serve as a basis for formulating policies to strengthen vocational schools, particularly in terms of integrating infrastructure investment and the development of the quality of teaching staff.

Limitations and Directions for Further Research

This study has several limitations, including its relatively small sample size confined to two public vocational schools in Yogyakarta, which may restrict the generalizability of the findings to other contexts. The sole reliance on a quantitative ex post facto design also limits the ability to establish causality or capture in-depth contextual experiences. Furthermore, the focus exclusively on the Machining Engineering program narrows the applicability of the results to other vocational disciplines. Additionally, the use of self-reported data for employability skills may introduce potential response bias.

Future research should address the following recommendations:

1. Expand the sample to include more schools from diverse regions to improve the representativeness and national relevance of the findings.
2. Adopt a mixed-methods approach to incorporate qualitative perspectives from teachers, industry partners, and employers, thereby enabling a more comprehensive analysis.

3. Implementing longitudinal research to better assess causality and long-term effects on employability.
4. Expanding the research focus to encompass additional vocational programs, enabling cross-disciplinary comparisons.
5. Including employer assessments of graduates' skills to increase the practical value and credibility of the findings.
6. Analyzing the implementation and obstacles of the TPACK framework in vocational teaching to provide actionable insights for educators.

The outcomes of this study are anticipated to inform improvements in vocational education systems. Enhancing teaching quality, facilities, and employability skills may increase work readiness and industry relevance. The insights generated by this research have the potential to benefit vocational education.

ACKNOWLEDGEMENT

The author would like to express his deepest gratitude to the Education Fund Management Institution / Lembaga Pengelola Dana Pendidikan (LPDP), the principals, teachers, and students of SMKN 2 Yogyakarta and SMKN 3 Yogyakarta for their participation and support during the data collection process. Appreciation is also extended to the Department of Mechanical Engineering Education at Universitas Negeri Yogyakarta, whose academic guidance and research support were crucial in the successful completion of this research. Special thanks are extended to all parties who have helped directly or indirectly in the completion of this research. We are also grateful for the constructive feedback from our fellow researchers and reviewers, which has strengthened the quality of this work.

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