



Contribution of the Heavy Equipment Concentration Industry Class Program to Work Readiness in Line with Industry 4.0 Requirements at Vocational High School

Finto Purwanto^{1*}; Didik Nurhadi²; Widiyanti³

^{1,2,3}Pendidikan Kejuruan, Universitas Negeri Malang, Indonesia

^{1*}Corresponding Email: fintoprwnt77@gmail.com

Article History:

Received: Sep 08, 2025

Revised: Oct 01, 2025

Accepted: Nov 04, 2025

Online First: Nov 27, 2025

Keywords:

Industry 4.0,
Industrial Class,
Industry Needs,
Heavy Equipment
Engineering,
Work Readiness.

Kata Kunci:

Industri 4.0,
Kebutuhan Industri,
Kelas Industri,
Kesiapan Kerja,
Teknik Alat Berat.

How to cite:

Purwanto, F., Nurhadi, D., & Widiyanti, W. (2025). Contribution of the Heavy Equipment Concentration Industry Class Program to Work Readiness in Line with Industry 4.0 Requirements at Vocational High School. *Edunesia : Jurnal Ilmiah Pendidikan*, 6(3), 2015-2027.

This is an open-access article under the CC-BY-NC-ND license



Abstract: This study aims to examine how the concentration of heavy equipment in industrial classes contributes to the work readiness of Vocational High School graduates, particularly in terms of meeting the demands of Industry 4.0. This research employs a literature review approach by analyzing relevant studies, reports, and publications on vocational education, work readiness, and competencies in the digital era. The findings indicate that the heavy equipment concentration industrial class program enhances graduates' work readiness through the integration of up-to-date technology in the curriculum and a practice-based learning model that develops both technical and soft skills. Graduates are expected to possess technological literacy, problem-solving abilities, and adaptability to digitalization and automation in modern industries. However, this study is limited to secondary data analysis and lacks empirical field data, which should be addressed in future research. The findings have broader implications not only for education but also for the social and economic dimensions of vocational development. By strengthening collaboration between schools and industries, this model enhances graduate employability, promotes local economic growth, and cultivates a skilled workforce aligned with national industrial transformation objectives. Overall, the program has a positive impact; nevertheless, curriculum updates are essential to remain responsive to ongoing industrial changes.

Abstrak: Penelitian ini bertujuan untuk mengkaji kontribusi program kelas industri konsentrasi alat berat terhadap kesiapan kerja lulusan SMK dalam menghadapi tuntutan Industri 4.0. Studi ini menggunakan analisis literatur, laporan, dan berbagai publikasi yang berkaitan dengan pendidikan vokasi, kompetensi digital, serta kesiapan kerja di era modern. Hasil analisis menunjukkan bahwa program kelas industri konsentrasi alat berat mampu meningkatkan kesiapan kerja lulusan melalui integrasi teknologi terkini dalam kurikulum dan penerapan pembelajaran berbasis praktik. Pendekatan ini memungkinkan siswa memperoleh keterampilan teknis yang kuat sekaligus soft skills seperti kemampuan berpikir kritis, pemecahan masalah, dan adaptasi terhadap digitalisasi serta otomasi industri. Meskipun demikian, penelitian menemukan beberapa kendala, antara lain keterbatasan pembaruan peralatan teknologi di ruang praktik dan kebutuhan peningkatan keterampilan digital yang lebih luas di luar kompetensi teknis alat berat. Secara keseluruhan, program ini memberikan dampak positif terhadap peningkatan kualitas lulusan, namun perbaikan kurikulum dan modernisasi sarana praktik diperlukan agar selaras dengan perkembangan pesat dunia industri.

A. Introduction

Current labor needs continue to evolve in response to advancements in modern technology, including digital control system automation and data analytics. Technological progress in the Industry 4.0 era is rapidly reshaping the world of work. Consequently, workers must continuously adjust their competencies and master modern industrial technologies to contribute optimally to the heavy equipment sector. Industry 4.0 marks a new era characterized by the integration of advanced digital technologies into production and operational processes, thereby fundamentally transforming labor requirements. Automation, control systems, and data analytics are now essential components, demanding a workforce proficient in both technical and adaptive skills (Jiang et al., 2024; Huo et al., 2024; Sun et al., 2023). These advancements represent a paradigm shift in job qualifications, where traditional skills are increasingly being replaced by multidisciplinary competencies that utilize technology for efficiency and innovation (Singh et al., 2022; Mi, 2024).

In the context of vocational education, aligning curricula with industrial needs is crucial, particularly for institutions like Vocational High School, which play a strategic role in preparing talent for the heavy equipment industry. The Heavy Equipment Industry Class program serves as a strategic initiative to bridge the gap between technological innovation and vocational training (Xu, 2024). Several studies highlight that vocational education must evolve in tandem with technological advancements, emphasizing practical learning through internships, industry partnerships, and hands-on experience (Hamilton et al., 2021; Changqing et al., 2024; Dauth et al., 2021). These approaches ensure that students not only gain theoretical knowledge but also the employability skills needed to compete in a dynamic labor market.

The implementation of the Heavy Equipment Industry Class program at Vocational High School reflects this alignment through curriculum synchronization with industry standards, teacher training, guest lectures from professionals, and structured internships. These initiatives strengthen students' readiness by combining school-based learning and industry-based experiences (Amparian et al., 2022; Gao et al., 2023). Furthermore, such collaboration enhances the link and match between education and employment, a crucial factor in increasing graduate quality and reducing the skill mismatch commonly found in vocational education.

However, despite the growing number of studies on industrial class implementation in vocational schools, few have specifically examined its contribution to work readiness in the heavy equipment field within the context of Industry 4.0. Previous research tends to focus on curriculum alignment, teaching factory practices, or general employability outcomes, but lacks in-depth discussion on how heavy equipment specialization programs address digital transformation, automation, and data-driven industry demands. This gap highlights the need to examine how the Heavy Equipment Concentration Industry Class at Vocational High School equips students with both technical expertise and adaptive digital competencies necessary in modern industries.

Therefore, this study aims to analyze the contribution of the Heavy Equipment Concentration Industry Class program at Vocational High School to the work readiness of its graduates, in line with the requirements of Industry 4.0. Specifically, it assesses how curriculum design, industry collaboration, and practice-based learning influence students' competencies, attitudes, and employability in response to the evolving expectations of the industrial sector.

B. Method

This study employed a literature review method to determine how the concentration of heavy equipment in industrial classes influences the work readiness of vocational school graduates in meeting Industry 4.0 demands. The research focused on synthesizing and analyzing previous studies, reports, and official publications related to vocational education, industrial classes, and employability competencies in the digital era.

A total of 50 scientific articles published between 2017 and 2024 were initially identified using databases such as Google Scholar, ScienceDirect, and ResearchGate. The search used the keywords: "industrial class," "work readiness," "heavy equipment engineering," and "Industry 4.0." After screening, 12 journals were selected for in-depth analysis based on the following criteria: (1) Relevance: The articles must directly discuss industrial classes, vocational education, or heavy equipment-related training; (2) Quality and Credibility: Only peer-reviewed and nationally accredited (Sinta 2 or higher) or internationally indexed (Scopus, WoS) journals were included; (3) Recency: Publications were limited to the last seven years (2017–2024) to ensure up-to-date relevance with Industry 4.0 contexts; and (4) Methodological Rigor: Studies employing qualitative, quantitative, or mixed-method approaches with clear analytical frameworks were prioritized.

The data analysis followed three main steps: (1) identification, (2) screening, and (3) thematic synthesis. During the identification stage, all articles were collected and categorized according to the study's focus. Screening involved evaluating abstracts and full texts to ensure that only articles addressing industrial class programs or work readiness indicators were retained. Finally, the thematic synthesis process grouped findings into main categories: curriculum relevance, industry collaboration, skills development, and employability outcomes.

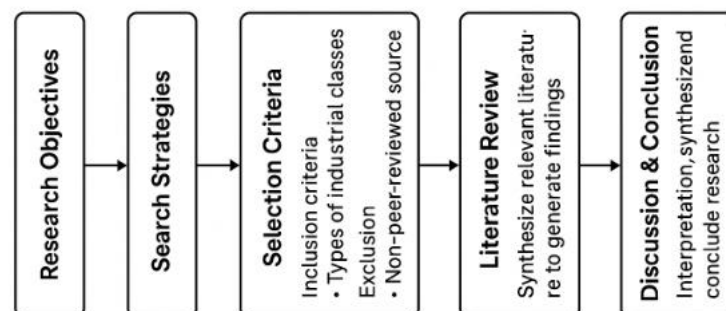


Figure 1. Research Flow Diagram

C. Result

1. Data Analysis

Researchers began by reviewing 50 academic articles related to vocational education, industrial class programs, and work readiness between 2017 and 2024. After a systematic screening using inclusion criteria (relevance, credibility, recency, and methodological rigor), 12 articles were selected for in-depth review. These studies represent both national and international sources that discuss the implementation of industrial classes and employability in the context of Industry 4.0. The distribution of analyzed articles by year and source type is presented in Figure 2 below:

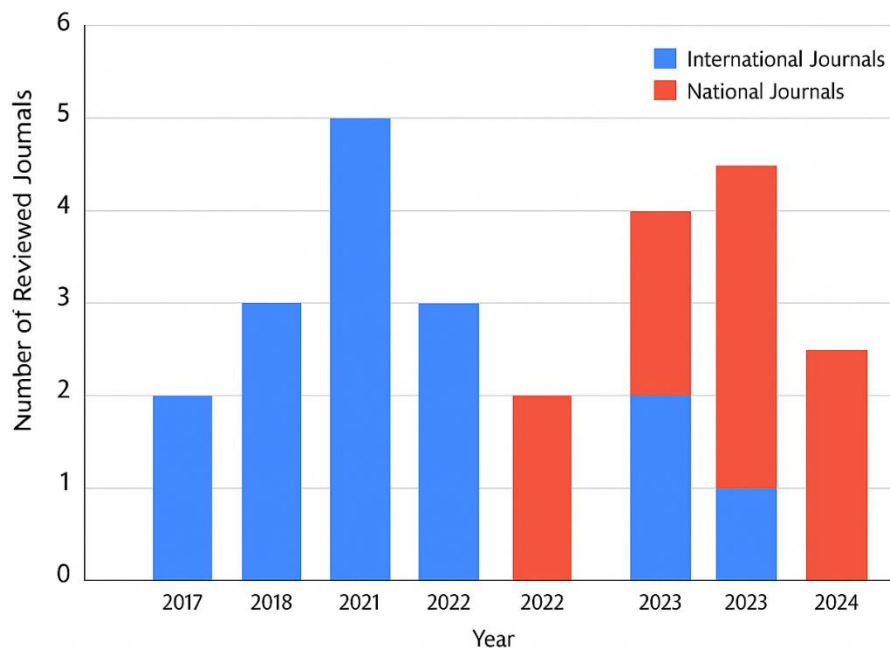


Figure 2. Distribution of International and National Journals (2017–2024)

The bar chart indicates that international journals dominated the literature between 2020 and 2023, showing consistent global attention to vocational education transformation. National studies began to rise significantly in 2022 and reached their peak in 2024, reflecting the growing awareness of Indonesian researchers on aligning vocational education with Industry 4.0 competencies. This pattern suggests a balanced integration of global and local perspectives in recent vocational research.

2. Critical Appraisal

Each selected article was critically evaluated based on methodological soundness, data validity, and relevance to the study's focus. The appraisal criteria covered: (1) Clarity of research objectives and alignment with research questions, (2) Appropriateness of research design and sampling techniques, (3) Reliability and validity of instruments used, (3) Relevance of data analysis techniques, and (4) Consistency between research findings and conclusions. Articles that passed the critical appraisal stage demonstrated

methodological rigor and provided empirical evidence on how industrial classes, curriculum alignment, and school–industry collaboration improve students’ work readiness. This process ensured that the selected studies were suitable for building a comprehensive and credible synthesis.

3. Literature Review Results

Based on the review of 12 selected studies, it was found that industrial class programs play a significant role in improving students’ work readiness through: (1) Strengthening technical competencies related to machinery, safety, hydraulics, and electrical systems; (2) Developing soft skills, including discipline, responsibility, and communication; (3) Fostering collaboration between schools and industries to ensure curriculum relevance; and (4) Increasing student motivation and learning engagement through hands-on experience. International studies (Syauqi, 2020; Gao et al., 2023) emphasized the importance of integrating automation and data analytics into vocational curricula, while national research (Safitri, 2022) highlighted challenges such as limited technological facilities and uneven teacher training. The analysis confirms that industrial class implementation has both technical and socio-economic impacts, improving graduate employability and supporting regional workforce development.

4. Matrix of Literature Data Analysis

The matrix below summarizes the findings of the 12 reviewed articles, organized by title, author(s), publication source, and main research results.

Table 1. Matrix of Literature Data Analysis

No	Title	Authors	Journal / Source	Main Research Results (Expanded)
1	Pengelolaan Kelas Industri di Sekolah Menengah Kejuruan	Priambudi, P., Mahmudah, F. N., & Susatya, E. (2020)	Jurnal Pendidikan Teknologi Kejuruan	The study explains how industry-based class management in vocational schools enhances cooperation between schools and partner companies. It finds that structured management, clear competency mapping, and continuous evaluation directly strengthen students’ work readiness and job placement outcomes.
2	Perkembangan Sektor Industri terhadap Penyerapan Tenaga Kerja dan PDRB di Provinsi Kalimantan Selatan	Amparian, D., Saipudin, S., & Chandriyanti, I. (2022)	Ecoplan, 5(1)	This article demonstrates that industrial sector expansion is positively correlated with regional employment absorption and economic growth. It highlights that vocational readiness and industrial collaboration programs can accelerate labor productivity in line

No	Title	Authors	Journal / Source	Main Research Results (Expanded)
				with regional industrial development.
3	Effect of Industrial Robot Use on China's Labor Market: Evidence from Manufacturing Industry Segmentation	Gao, X., Luo, C., & Shou, J. (2023)	Intelligent and Converged Networks, 4(2)	This study demonstrates that automation and robotics have a significant impact on labor-market structures, requiring higher technical competencies. It provides evidence that integrating robotic technology into vocational training boosts graduates' adaptability and efficiency.
4	How Automated Machines Influence Employment in Manufacturing Enterprises	Jiang, H., Ge, Y., Yang, C., & Yu, H. (2024)	Plos One, 19(3)	The authors find that machine automation alters employment patterns by reducing the demand for routine jobs and increasing the demand for skilled operators. They recommend that vocational institutions emphasize digital and automation training to maintain the relevance of their workforce.
5	"Machine Replacement" or "Job Creation": How Artificial Intelligence Impacts Employment Patterns in China's Manufacturing Industry	Huo, Q., Ruan, J., & Cui, Y. (2024)	Frontiers in Artificial Intelligence	AI integration initially displaces repetitive labor but creates new high-skill positions. The study suggests aligning vocational curricula with AI-driven industrial processes to sustain employability.
6	Farm Labor Productivity and the Impact of Mechanization	Hamilton, S., Richards, T., Shafran, A., & Vasilaky, K. (2021)	American Journal of Agricultural Economics	This paper evidences that mechanization significantly improves labor productivity but requires reskilling programs. Its relevance to vocational education lies in demonstrating how technical training enables workers to adapt to mechanized systems.
7	Low-End Lock-in of the Chinese Equipment Manufacturing Industry and the Global Value Chain	Li, Y., Sun, H., Huang, J., & Huang, Q. (2020)	Sustainability, 12(7)	The authors identify that industrial competitiveness depends on human-capital upgrading and technology-based education. They emphasize that vocational institutions must continuously align with global production standards.
8	Development Pathways for Vocational Education	Xu, Z. (2024)	Lecture Notes in Education, Psychology and	Xu outlines reform strategies for vocational training in preparation for Industry 4.0, emphasizing international collaboration, data-

No	Title	Authors	Journal / Source	Main Research Results (Expanded)
	and Training (VET) in China		Public Media, 52(1)	driven curriculum design, and continuous professional development for teachers. This framework directly supports the concept of industrial class transformation.
9	Does Industrial Intelligence Promote Sustainable Employment?	Mi, G. (2024)	Sustainability, 16(10)	The study confirms that industrial intelligence has a positive impact on sustainable employment when combined with digital literacy in the workforce. It stresses integrating smart-technology modules into vocational education.
10	Industrial Intelligent Infrastructure, Labor Inflow, and Integration of the Two Industries – Empirical Analysis of Guangdong	Changqing, X., Xinyue, Z., & Chen, J. (2024)	Academic Journal of Business & Management, 6(4)	The research suggests that intelligent infrastructure promotes industrial integration and the recruitment of skilled labor. Its implications for vocational schools lie in promoting technology-based learning to meet the needs of labor market integration.
11	An Empirical Study to Identify Determinants of the Effect of Technology on the Labour Market in the Emerging Indian Economy	Singh, N., Chaturvedi, D., & Chhabra, N. (2023)	Journal of International Economics & Research	This article reveals that technological transformation reshapes labor demand and necessitates lifelong learning. It highlights vocational education as a critical medium for reducing digital skill gaps.
12	China's Digital Economy and Enterprise Labor Demand: The Mediating Effects of Green Technology Innovation	Sun, Z., Liu, J., & Tansuchat, R. (2023)	Sustainability, 15(15)	Findings show that digital innovation enhances employment through eco-efficient production. The study strengthens the argument that integrating sustainability principles within industrial class programs increases graduates' relevance in Industry 4.0.

D. Discussion

The findings of this study confirm that the Heavy Equipment Concentration Industry Class program significantly enhances students' work readiness by improving their technical competence, work attitude, and adaptability. These results align with previous studies (Syauqi, 2020; Asfiyanur et al, 2018; Lencana et al., 2023), which consistently emphasize that industrial-based learning focusing on equipment operation, safety, and maintenance increases students' operational readiness and professionalism. The integration of vocational curricula with Standar Kompetensi Kerja Nasional Indonesia (SKKNI) also

ensures that learning outcomes remain relevant to industry needs. This alignment is evident in the collaboration between schools and industry partners, where synchronized curricula and certification systems have produced graduates with stronger employability profiles.

Furthermore, the positive impact of industrial internships supports the argument by [Lencana et al \(2023\)](#) that direct industrial exposure enhances students' motivation and confidence in adapting to real-world work environments. Similar to [Mardiana \(2021\)](#), this study confirms that industrial classes nurture discipline and responsibility – two essential components of employability in vocational contexts. The results also reinforce [Asbari et al \(2020\)](#) finding that work readiness depends not only on cognitive and technical skills but also on positive work ethics and attitudes. These findings suggest that the Heavy Equipment Industry Class effectively bridges the gap between theoretical instruction and industrial application by providing authentic learning experiences that mirror real workplace conditions.

However, despite these positive outcomes, several challenges remain. Compared to [Prianto & Qomariyah \(2019\)](#), who found that the Teaching Factory model successfully balanced technical and soft skills, this study reveals that the Heavy Equipment Industry Class remains predominantly technical in focus. The integration of Industry 4.0 elements such as automation, data processing, and digital literacy has not been fully implemented in most vocational programs. This observation aligns with [Inderanata & Sukardi \(2018\)](#), who emphasized that vocational schools must enhance digital competence, creative problem-solving, and adaptability to meet the changing demands of modern industries. Limited technological infrastructure, uneven teacher upskilling, and insufficient digital resources also contribute to the slow adoption of technology-based learning.

Overall, the findings demonstrate that collaborative industry-based learning effectively prepares students for employment while reinforcing the importance of sustainable innovation in vocational education. This study supports and extends the works of [Syauqi et al \(2020\)](#), [Asfiyanur et al \(2018\)](#), and [Safitri et al \(2021\)](#) by highlighting that employability is best achieved when vocational programs are strengthened through continuous industry partnerships and technological adaptation. In the context of Industry 4.0 transformation, the Heavy Equipment Industry Class program serves as an effective model for linking education with industry, provided that future developments focus on digital integration, smart learning environments, and teacher competency enhancement to ensure long-term relevance and competitiveness.

E. Implication

The findings of this study carry significant implications for the development of vocational education, industrial collaboration, and workforce readiness in the context of Industry 4.0. The Heavy Equipment Concentration Industry Class Program demonstrates that close cooperation between vocational schools and industrial partners can substantially improve graduates' technical competencies, employability, and adaptability to digital transformation. This result underscores the critical need for an education model that not

only emphasizes theoretical instruction but also incorporates practical, technology-oriented experiences that reflect real-world industrial practices.

From an educational perspective, the implementation of industry-based learning strengthens curriculum relevance and ensures that learning outcomes are directly aligned with industrial standards such as *Standar Kompetensi Kerja Nasional Indonesia (SKKNI)*. Schools that integrate industrial collaboration into their teaching systems can foster a learning environment that encourages active problem-solving, innovation, and teamwork. This shift from traditional classroom teaching to practice-based learning is essential for developing both technical and soft skills, which are equally important for employability in the digital era. Furthermore, teacher competency development becomes a strategic priority, as educators must continually upgrade their knowledge and pedagogical skills to deliver Industry 4.0-aligned learning content effectively.

From an industrial perspective, the findings suggest that partnership-based vocational education can serve as a sustainable strategy for human resource development in industries. Through participation in curriculum design, internships, and certification programs, industries can ensure that prospective workers are equipped with skills relevant to their technological and operational needs. This collaborative model reduces recruitment costs, minimizes skill mismatches, and enhances industrial productivity. In particular, heavy equipment companies benefit from a workforce that is not only proficient in mechanical operations but also capable of managing digitalized systems, automation, and predictive maintenance, essential components of modern industrial ecosystems.

From a policy perspective, the study suggests that government and educational policymakers should prioritize the institutionalization of industrial class models within the national vocational education framework. Strengthening policy support in areas such as curriculum modernization, teacher training, digital infrastructure, and industry partnerships is crucial to achieving equitable and sustainable vocational transformation. Incentives for industries that actively participate in education, such as tax reductions or training subsidies, could further enhance the effectiveness of collaboration. Moreover, policies promoting the integration of emerging technologies, including artificial intelligence, the Internet of Things (IoT), and virtual simulation, within vocational training will ensure that students remain competitive and future-ready.

Finally, from a socio-economic perspective, the implications of this research extend beyond educational reform. Well-designed industrial class programs contribute to regional economic growth, local employment absorption, and social mobility by creating a bridge between education and productive industry sectors. As vocational graduates become more competent and employable, their participation in the workforce supports national industrial development and strengthens Indonesia's position within the global Industry 4.0 value chain. Thus, the success of the Heavy Equipment Industry Class Program provides a replicable model for other vocational disciplines aiming to balance education, technology, and industrial innovation.

In summary, the findings imply that sustainable collaboration between schools, industries, and government institutions is the cornerstone of future-ready vocational education. To fully realize this potential, continuous curriculum innovation, teacher professional development, and enhancement of digital infrastructure must be prioritized. Only through such a holistic and collaborative approach can vocational education truly fulfill its mission as the engine of national competitiveness in the digital industrial era.

F. Limitation and Suggestion for Further Research

This study is limited to the use of secondary data obtained from literature reviews, reports, and prior research related to vocational education and industrial class programs. The absence of primary data from field observations, student performance assessments, or direct collaboration with partner industries restricts the ability to validate the findings empirically. Consequently, this study may not fully capture the contextual differences in implementation across various vocational schools, particularly in terms of facility quality, teacher competencies, and the intensity of industry collaboration. Furthermore, since the reviewed literature spans only from 2017 to 2024, the analysis may not adequately reflect the latest technological advancements in Industry 4.0, such as the integration of artificial intelligence, data-driven maintenance, and smart automation systems that are increasingly shaping industrial practices. Methodologically, the study employs a qualitative synthesis approach, which does not involve statistical testing, thereby limiting the ability to establish causal relationships between industrial class participation and students' work readiness outcomes.

In light of these limitations, future research is recommended to employ quantitative or mixed-method designs that integrate surveys, structured interviews, and longitudinal observations to provide stronger empirical evidence. Comparative studies among vocational schools with different industrial concentrations would also be beneficial to identify best practices and key challenges in aligning education with Industry 4.0 standards. Additionally, it is suggested that upcoming research explore the use of digital learning environments – such as simulation-based training, augmented reality, and IoT-supported laboratories – to enhance students' digital and adaptive competencies. Further investigation into teacher upskilling programs and collaborative curriculum design between schools and industries is also essential to ensure sustainability and relevance in vocational training. By addressing these aspects, future studies can provide a more comprehensive and evidence-based understanding of how industrial class programs contribute to improving work readiness and supporting national industrial transformation in the digital era.

G. Conclusion

Industry-based programs have a significant impact on preparing graduates to face challenges in the workplace. Students benefit greatly from collaboration with heavy equipment companies. Industry-based programs can provide students with both theoretical knowledge and practical skills in the industry, offering hands-on experience in real-world

work. This learning emphasizes that the curriculum must align with national competency standards (SKKNI) to ensure that graduates are prepared to compete in the job market, particularly in meeting the requirements of Industry 4.0. Furthermore, it has been proven that industry involvement in the education process increases students' desire to learn and provides them with a better understanding of the world of work. This program also emphasizes the importance of teachers receiving ongoing training so that they can teach their students the latest skills. Overall, the industrial class program at Vocational High School has successfully demonstrated that an education approach integrated with industry can produce a skilled workforce that meets market needs.













References

- Amparian, D., Saipudin, S., & Chandriyanti, I. (2022). Perkembangan Sektor Industri Terhadap Penyerapan Tenaga Kerja dan Produk Domestik Regional Bruto (PDRB) Pada Sektor Industri di Provinsi Kalimantan Selatan. *Ecoplan*, 5(1), 1-19. <https://doi.org/10.20527/ecoplan.v5i1.271>
- Asbari, M., Hyun, C. C., Wijayanti, L. M., WINANTI, W., Fayzhall, M., & Putra, F. (2020). Hard skills dan soft skills: Apa Membangun Inovasi Guru Sekolah Islam? *Journal EVALUASI*, 4(1), 143-172.
- Asfiyanur, E. P., Sumardi, K., Rahayu, Y., & Putra, R. C. (2018, February). The Relevance of Vocational High School Curriculum with the Requirement of the Heavy Equipment Industries. In *IOP Conference Series: Materials Science and Engineering*, 306(1), 012037. IOP Publishing.
- Changqing, X., Xinyue, Z., & Chen, J. (2024). Industrial Intelligent Infrastructure, Labor Inflow, and Integration of the Two Industries – Based on the Empirical Analysis of Guangdong. *Academic Journal of Business & Management*, 6(4). <https://doi.org/10.25236/ajbm.2024.060419>
- Dauth, W., Findeisen, S., Suedekum, J., & Woessner, N. (2021). The Adjustment of Labor Markets to Robots. *Journal of the European Economic Association*, 19(6), 3104-3153. <https://doi.org/10.1093/jeea/jvab012>
- Gao, X., Luo, C., & Shou, J. (2023). Effect of Industrial Robot Use on China's Labor Market: Evidence from Manufacturing Industry Segmentation. *Intelligent and Converged Networks*, 4(2), 106-115. <https://doi.org/10.23919/icn.2023.0011>
- Hamilton, S., Richards, T., Shafran, A., & Vasilaky, K. (2021). Farm Labor Productivity and the Impact of Mechanization. *American Journal of Agricultural Economics*, 104(4), 1435-1459. <https://doi.org/10.1111/ajae.12273>
- Huo, Q., Ruan, J., & Cui, Y. (2024). "Machine Replacement" or "Job Creation": How Does Artificial Intelligence Impact Employment Patterns in China's Manufacturing Industry?. *Frontiers in Artificial Intelligence*, 7. <https://doi.org/10.3389/frai.2024.1337264>

- Inderanata, R. N., & Sukardi, T. (2023). Investigation Study of Integrated Vocational Guidance on Work Readiness of Mechanical Engineering Vocational School Students. *Heliyon*, 9(2), e13333. <https://doi.org/10.1016/j.heliyon.2023.e13333>
- Jiang, H., Ge, Y., Yang, C., & Yu, H. (2024). How Automated Machines Influence Employment in Manufacturing Enterprises?. *Plos One*, 19(3), e0299194. <https://doi.org/10.1371/journal.pone.0299194>
- Lencana, M. D., Purwanto, W., & Maksun, H. (2023). Kontribusi Praktik Kerja Industri Menjadi Minat Peserta Didik Terhadap Jurusan Teknologi Alat Berat. *JTPVI: Jurnal Teknologi dan Pendidikan Vokasi Indonesia*, 1(2), 191-200.
- Li, Y., Sun, H., Huang, J., & Huang, Q. (2020). Low-End Lock-In of Chinese Equipment Manufacturing Industry and the Global Value Chain. *Sustainability*, 12(7), 2981. <https://doi.org/10.3390/su12072981>
- Mardiana, P. L. (2021). Peningkatan Potensi Peserta Didik Melalui Program Pembelajaran Vocational Skill di Madrasah Aliyah Ma'arif Al-Azhar Karangrejo Sampung Ponorogo (Doctoral dissertation, IAIN Ponorogo).
- Mi, G. (2024). Does Industrial Intelligence Promote Sustainable Employment? *Sustainability*, 16(10), 3896. <https://doi.org/10.3390/su16103896>
- Priambudi, P., Mahmudah, F. N., & Susatya, E. (2020). Management of Industrial Class in Vocational Education. *Jurnal Pendidikan Teknologi Kejuruan*, 3(2), 87-97. <https://doi.org/10.24036/jptk.v3i2.6823>
- Prianto, A., & Qomariyah, O. N. (2019). Pengaruh Penerapan Teaching Factory Dan Keterlibatan Dalam Pembelajaran Terhadap Kesiapan Bekerja Lulusan SMK. In *Prosiding Conference on Research and Community Services*, 1, No. 1, pp. 968-991).
- Safitri, M., Mashudi, M., & Achmadi, A. (2022). Pengaruh Prakerin dan Konsep Diri terhadap Rencana Karir Peserta Didik Kelas XII SMKS Mandiri. *Jurnal Pendidikan dan Pembelajaran Khatulistiwa (JPPK)*, 11(8), 900-911. <https://doi.org/10.26418/jppk.v11i8.57307>
- Singh, N., Chaturvedi, D., & Chhabra, N. (2022). An Empirical Study to Identify Determinants of Effect of Technology on Labour Market in Emerging Indian Economy. *Journal of Informatics Education and Research*, 2(1), 10-21. <https://doi.org/10.52783/jier.v2i1.411>
- Sun, Z., Liu, J., & Tansuchat, R. (2023). China's Digital Economy and Enterprise Labor Demand: The Mediating Effects of Green Technology Innovation. *Sustainability*, 15(15), 11682. <https://doi.org/10.3390/su151511682>
- Syauqi, K., Munadi, S., & Triyono, M. B. (2020). "Students' perceptions toward vocational education on online learning during the COVID-19 pandemic." *International Journal of Evaluation and Research in Education (IJERE)*, 9(4), 881-888. <http://doi.org/10.11591/ijere.v9i4.20766>

Xu, Z. (2024). Development Pathways for Vocational Education and Training (VET) in China. *Lecture Notes in Education Psychology and Public Media*, 52(1), 212-218. <https://doi.org/10.54254/2753-7048/52/20241598>

Author's Biography

	<p>Finto Purwanto, S.T.    He was born on December 27, 1987, in Malang, Indonesia. He currently works as a Heavy Equipment Engineering Teacher at a vocational high school and is pursuing a Master's degree at Universitas Negeri Malang. Email: fintoprwnt77@gmail.com</p>
	<p>Didik Nurhadi, S. Pd., M. Pd., Ph. D.    He was born on January 20, 1979, in Blitar, Indonesia. He is currently an Associate Professor at the Faculty of Engineering, Universitas Negeri Malang. He earned his Bachelor's and Master's degrees in Mechanical Engineering Education from Universitas Negeri Malang, and his Doctoral degree in Vocational and Technical Education from National Yunlin University of Science and Technology, Taiwan. His research interests include vocational education, work-based learning, entrepreneurship education, and digital transformation in teaching and learning. Email: didik.nurhadi.ft@um.ac.id</p>
	<p>Dr. Widiyanti, M.Pd.    She was born on August 14, 1966, in Klaten, Indonesia. She is a Senior Lecturer at the Faculty of Engineering, Universitas Negeri Malang. She holds a Bachelor's degree in Mechanical Engineering Education from IKIP Surabaya, a Master's degree in Vocational and Technical Education from IKIP Jakarta, and a Doctoral degree in Vocational Education from Universitas Negeri Malang. Her expertise includes vocational education, industrial psychology, educational evaluation, and curriculum development. She has been actively involved in teaching at the undergraduate, master's, and doctoral levels. Email: widiyanti.ft@um.ac.id</p>