

Implementing and Managing the Teaching Factory Learning Model at Vocational Schools

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Abstract: This research explores the implementation and management of the teaching factory (TEFA) models at Vocational High School (SMK) St. Mikael, Surakarta, Indonesia. The research focuses on the management of production units owned by the school and how the school collaborated in industrial cooperation with relevant enterprises. A qualitative approach with a case study method was employed, collecting data through documentation, interviews, and observation. The findings reveal that the teaching factory is implemented through block schedules and job sheets to enhance student skills, with professional management of the production unit. Additionally, the industrial cooperation bridged by the school and its business partners has involved apprenticeships, product marketing, worker deployment, and industrial work visits. Among these four programs, apprenticeships are believed to be the most effective in enhancing students' vocational competencies. Implementing the TEFA model has assisted the school in equipping its students with competencies aligned with the industrial demands for qualified and competent workers. The study suggests that other vocational schools implementing TEFA might consider managing their production unit by employing block schedules and job sheets in the production unit, and building industrial partnerships to address the demand of the current industry trends.

Keywords: Industrial cooperation; School production unit; Teaching factory

Introduction

Technical and vocational education and training (TVET) is vital in building skilled and competent human resources, which are indispensable for a country's economic growth. Without a doubt, the connection between jobs and the prominence of TVET is substantial and extending (Billett, 2020). It serves a crucial duty in preparing students to work in specialized areas by providing them with the necessary skills and competencies that meet industry expectations (Cai & Kosaka, 2024). In a broader sense, TVET aims to meet economic, social, and environmental demands by equipping youth and adults with skills for employment

and entrepreneurship, promoting equitable and sustainable economic growth, and supporting the transition to digital and ecological economies for sustainable development (UNESCO, 2022). It is clear that the primary goals of TVET are to encourage and improve students' interests and potential through the implementation of technical-theoretical knowledge and practical skills. The interesting point is that TVET is even appointed as the solution for a country to catch up economically (McGrath & Yamada, 2023).

Given the importance of TVET, vocational high schools (VHS) or *Sekolah Menengah Kejuruan* (SMK) play a critical role in implementing its principles and objectives. VHS, as institutions that provide TVET, aim

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to encourage and improve students' interests and potential through the implementation of technical-theoretical knowledge and practical skills. In the Indonesian context, VHS is managed by considering the aspect of equality and justice, life skills, and local cultural value-based curriculum (Yasdin & Muksins, 2024). In the early 2000s, Indonesian government began expanding the program of VHS (Yoana et al., 2024), with the orientation of country advancement (Yasdin et al., 2023). These recent years, in the report of UNESCO, the Indonesian government aims to improve the employability and competitiveness of its workforce by rejuvenating the TVET system at the national, regional, and global levels (UNESCO-UNEVOC, 2020), signifying a serious endeavor in developing quality TVET in this country.

Despite its significant existence, VHS in Indonesia encounters various challenges in its development. Curriculum and learning systems that are less relevant to current business demands prevent the effectiveness of VHS learning. This is due to difficulties in adjusting the current industry needs to the school curriculum (Ogur, 2023). Additionally, the quantity of competent and qualified teachers has not been fulfilled. Most teachers traditionally deliver materials, with students passively listening. Materials taught at schools typically do not respond to industry demands. Another challenge is limited facilities, such as outdated practicum tools and machines, which also hinder the learning process. This corresponds to the study reported by Suharno et al. (2020) highlighting the issues of instructors, facilities, and industry support, amidst the efforts of developing VHS in Indonesia.

Considering these challenges, revitalization is necessary to upgrade and adjust the quality of vocational graduates to meet industry demands. One systematic and integral revitalization is implementing teaching or learning factories (TEFA), conceptualized on the use of school machinery, as well as production facilities approximating the industrial environment within the school (Mourtzis et al., 2023). This model is believed to provide students with hands-on experience in a real-world industry environment (Ogur, 2023). TEFA is one of the options to train students for competences that fit in concurrence with the needs of industrial competence (Diwanggoro & Soenarto, 2020). Its implementation necessitates creative and innovative management in the Industrial Revolution 4.0.

Some researchers have investigated how TEFA affects students in VHS. It was claimed that teaching factories influenced vocational school students' entrepreneurial competence, learning motivation, and interaction (Handayani et al., 2020). TEFA has also been discovered to promote students' learning involvement, such as learning participation, attention, commitment,

and communication (Prianto et al., 2020). Another research study demonstrated the advantages of using TEFA to improve subject-related competences in technical vocational schools (Roll & Ifenthaler, 2021). TEFA has also been shown to equip students with work readiness (Imran et al., 2024; Permata et al., 2021) and learning independence (Imran et al., 2024). Students' critical thinking and metacognitive aspects could also be promoted by TEFA implementation (Maksum et al., 2022). The studies described above have shed light on TEFA's potential to support students' learning at VHS.

Although previous studies have explored the impact of TEFA on students, this study focuses on analyzing production unit management and industrial cooperation that support teaching factory implementation, which have not been widely explored in the context of vocational schools in Indonesia. Effective production unit management and strong industrial cooperation are key factors in the successful implementation of teaching factories. Therefore, this study aims to analyze how these two factors are managed and contribute to the achievement of teaching factory goals at SMK St. Mikael."

The uniqueness of this research lies in its focus on the management of production units and cooperation between SMK St. Mikael and industrial companies. The school has its own factory or independent business unit, which provides students with hands-on experience. Additionally, the school has cooperation with more developed enterprises, which benefits schools, teachers, and students. This research will examine the implementation of teaching factories at SMK St. Mikael, including the management of production units and industry cooperation. By investigating this specific case, the research will provide detailed insights into the effective implementation of teaching factories. The findings will also highlight the benefits and challenges of industry cooperation in vocational education.

The research questions that will guide this study are: How does the school establish a teaching factory at the production unit, and how is the unit managed? What kinds of collaboration does the school have with the corporate sector outside of the school? By providing answers to these questions, the research will provide an in-depth comprehension of teaching factory implementation and industry collaboration. The findings will help policymakers, educators, and industry stakeholders with the concept and innovative ideas for improving the quality of TVET in VHS and preparing students for the workforce.

Method

This research aims to investigate the management of the production units and school partnership

cooperation with industrial companies as part of TEFA activities. The researchers employed a qualitative approach with a case study method (Yin, 2018) due to their interest in exploring the strengths and uniqueness of the TEFA applied at SMK St. Mikael in detail.

The research was conducted at St. Michael Catholic Technical High School (SMK St. Mikael) Surakarta, Jl. Mojo No. 1 Karangasem, Laweyan, Surakarta, Central Java, Indonesia. The data were obtained from several informants, including the school principal, the vice principal of curriculum, the head of the machining expertise program, and teachers and instructors who are directly involved in teaching factory learning every day. The informants were chosen using the snowball sampling technique as suggested by Creswell and Creswell (2018). The criteria of selection applied by the researchers are due to their relevant roles, direct involvement in the TEFA learning process, in-depth knowledge, leadership, and relevant expertise.

The techniques used to collect the data were interviews, observations, and documentation.

Interviews

Interviews have a crucial position as instruments in a case study. They can be utilized to gain profound insights into how people experience, feel, and understand the social world (Creswell & Creswell, 2018). In the present research, in-depth (focused) questions were utilized to get comprehensive data about the implementation of the teaching factory at SMK St. Mikael. The informants were interviewed individually.

Observations

Participatory and direct observation were also employed in this research. The observations were conducted to see students' activities when learning at school, working at the workshop of a production unit, and participating in the industrial cooperation with relevant companies. The researchers had a vast opportunity to see their interaction and identify challenges during learning.

Documentation

Relevant documents, such as minutes of meetings and certification documents, were chosen. The minutes of meetings offer a record of discussions, decisions, and actions taken by stakeholders, providing insight into the planning, implementation, and challenges of the TEFA at St. Mikael. The certification documents, such as ISO certification, demonstrate the production unit's commitment to quality management and adherence to industry standards.

Having obtained the required data, the analysis was employed by adapting the steps of Miles's et al. (2019), encompassing data condensation, data display,

and conclusion drawing/verification. In the step of data condensation, the interview transcripts were then transcribed using a non-verbatim technique, as this technique only transcribes the main ideas of the talk. This is considered effective, in contrast to verbatim, which is known as taking all details, yet is time-consuming (Hill et al., 2022). In this case, the researchers focused on the core or main ideas conveyed by the informants. The documents (minutes of meetings, ISO certification) and observation notes were reviewed to check the completeness.

Then the three sources of data were coded to identify patterns and themes. Similarities and differences emerged as the coded data were integrated across sources. This process helped to identify key insights into the TEFA model implemented in SMK St. Mikael. The condensed data was then organized into tables along with narration for easier comprehension. This helps to identify patterns and connections between industry partnerships, student outcomes, and factory learning. The analyzed data was used to draw conclusions about the TEFA learning at St. Mikael School. Before generating conclusions, the researchers compared the results to the current relevant literature to picture the TEFA implementation and management in different contexts.

To validate the data, triangulation was applied. The method applied is data and resource triangulation. In the data triangulation, the researchers verified results of interviews with written data found in documentation and activities conducted during the observation. While in the resource triangulation, the researchers confirmed information conveyed by the school principals, the vice principal of curriculum, the head of the machining expertise program, teachers and instructors.

Result and Discussion

School Production Unit

The data collected through observation, interviews, and documentation revealed that SMK St. Mikael has implemented a teaching factory model by establishing and managing a school production unit. This unit is operated like a professional company, with a focus on producing quality goods and services. To understand the context of this implementation, it is essential to portray the history of the production unit's establishment.

SMK St. Mikael is managed by the Karya Bakti Foundation, an educational foundation that oversees vocational education in high school (SMK St. Mikael) and higher education (Polytechnic ATMI). The foundation also operates several business companies, including PT. ATMI and PT. ADR provides opportunities for students to practice working in

apprenticeships and produce quality goods. Notably, PT. ATMI established a new division called PT. SMK IGI (Indonesia-Germany Institute), which serves as the production unit for SMK St. Mikael. This division was established after the school received a production machine aid from a cooperation institution between Indonesia and Germany. The production unit operates as a branch of PT. ATMI produces goods and earns profits while adhering to tax regulations.

By managing the production unit like a professional company, SMK St. Mikael provides students with hands-on experience in a real-world industrial setting. This approach enables students to develop their technical, methodological, social, and personal competencies, preparing them for the workforce.

Based on the interview and document analysis, the following chart shows the division of the foundation, including the position of the school production unit.

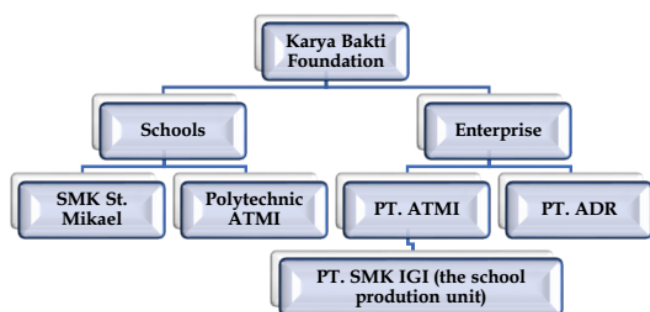


Figure 1. The organizational structure of the Karya Bakti Foundation

Block Schedule

In the implementation of the teaching factory model at the production unit, the researchers found that the students were introduced to block schedules and job sheets.

The block schedule implementation at SMK St. Mikael enables students to attain competence and completeness by integrating theory and practice. In this approach, students are divided into groups and allocated practicum time each week to apply learning materials and complete product orders. The block schedule is designed to foster students' soft skills and working culture, while also mirroring industry practices.

During practicum sessions, students follow a structured process aligned with the teaching factory model. This process involves accepting customer product orders, analysing the orders, preparing for production, manufacturing, and evaluating the products, and finally delivering them to customers. The vice principal of curriculum oversees the implementation of the block schedule through teacher

reports, while student evaluations are conducted through questionnaires and teacher feedback.

By integrating theoretical learning with practical application, the block schedule provides students with a comprehensive learning experience that prepares them for the demands of the industry. This approach enables students to develop their technical skills, problem-solving abilities, and teamwork capabilities, ultimately enhancing their employability and readiness for the workforce.

To illustrate this approach in action, the following is one of the direct observational activities conducted by the researchers together with the students during their practice in the production unit.



Figure 2. The researchers' participatory observation in the production unit

Job Sheet

In the practice of teaching factories with a block schedule, the students are provided with a job sheet as their guide to make, practice, or repair products. The job sheet contains preparation procedures, learning competence to achieve, supporting information, working steps and tasks, and evaluation or assessment. A job sheet is created with the intention of either achieving learning competence or producing useful products. Therefore, a job sheet should be in line with the block schedule and meet the criteria for standardized products.

The combination of block schedule and job sheet is utilized both in the classroom learning and practicum at the workshop of the school production unit. The informants mention that it aims at assisting every student's competency, producing standardized-worth-selling products, and completing orders from other particular companies. To support this, the school foundation has been trying to complete and rejuvenate all supporting facilities and infrastructure by allocating

a certain amount of money as an investment development contribution.

To manage the production unit, Karya Bakti Foundation has decided to manage the unit like a professional industrial company as the subsidiary company of PT. ATMI. The production unit, or PT. SMK IGI handles the management and accountability reports professionally. The management is separated from the school management. However, some of the school staff also work in this enterprise; the principal works as one of the directors on the board, the vice principal acts as the operational manager, and the teachers of productive subjects work as the supervisors of the subsidiary company. Additionally, the enterprise employs some people, as in a general company.

As the enterprise produces goods to sell, PT. SMK IGI surely earns some profit. The profit earned is divided among some parties with a particular percentage for: Karya Bakti Foundation; education subsidy for SMK St. Mikael to reduce students' practicum costs in the workshop. PT. SMK IGI provides material for the students' practicum, which in the end is used to produce excellent, worth-selling products, and some others are used to fulfill the orders of other companies, particularly PT. ATMI; investment in the production unit (buying machines and new equipment); and improving teachers' and staff's welfare.

SMK St. Mikael has become a sister school to other vocational schools in Surakarta due to PT SMK IGI's outstanding development in teaching factory implementation and professional management. They collaborate with Solo Techno Park (STP) to provide training for other vocational school students, which is mainly held at the SMK St. Mikael production unit or PT. SMK IGI.

There are some points to be highlighted from the findings. First, the teaching factory in SMK St. Mikael production unit is implemented through a block schedule and job sheet. These two have assisted every student's competence as well as resulted in standardized-worth-selling products and fulfilled orders from other companies. SMK St. Mikael notices that promoting the students' competence and producing standardized, sellable products are the objectives of the teaching factory.

Such practice is in harmony with teaching factory basics, as bringing industry to the classrooms (Jing et al., 2023), and integrating it into the curriculum. A teaching factory is a replication of the real factory, specifically to facilitate practical training in business, such as logistics, production, and technology processes (Lagorio & Cimini, 2024). Students were provided with challenges to participate in real-life circumstances where a real product and a real manufacturing environment were developed, allowing them to work on a topic relevant to

their future vocation (Anselmann et al., 2024). This approach aligns with the main objective of teaching factories is to emphasize the steps of manufacturing products, from planning to bringing the products into reality, and training students to optimize every single step of the production process.

Second, the school production unit is managed as a professional industrial company. The main benefit is to effectively introduce and expound students' competence and skills when working in a real industrial company. This unit is an integral part of TEFA, in which students can practice producing goods that customers demand (Diwanggoro & Soenarto, 2020). Within the curriculum framework, the production units owned by VHS are designed to achieve specific learning outcomes that align with predefined learning objectives (Rosidah & Sutirman, 2023) and meet the relevant demands of the current industry (Wahjusaputri & Bunyamin, 2022). Typical practice not only allows students to master knowledge and skills in the field, but also builds a mental attitude of being independent, responsible, and confident (Rosidah & Sutirman, 2023). These attitudes will be very much needed when they step up their career and succeed it.

In addition, the production unit can produce quality products as it is supported by a management team consisting of productive subject teachers with outstanding pedagogical and professional competence. They teach and train the students' competence and supervise the production process concurrently. In the end, the production unit can gain profitable earnings from producing the goods. This is the real financial benefit that a teaching factory can provide. Further, the financial profit can be used for a wider reach, that is, to promote the welfare of the institution. This is in harmony with a study reported by Marniati et al. (2020) underlining that teaching factories may upgrade a school's income and staff prosperity.

Partnership Cooperation with Industrial Companies

Table 1. The Industrial Cooperation of SMK St. Mikael

Type of cooperation	Subject involved
Industrial apprenticeships for students	Students under teacher and company supervision
Apprenticeships for teachers	Teachers of productive subjects
Product marketing	Management of PT. ATMI and students
Worker deployment	Students and companies facilitated by the school
Industrial work visit	Students

The data obtained from all instruments revealed that there are five types of cooperation undertaken by the school with professional and commercial companies.

They include industrial apprenticeships for students, apprenticeships for teachers, product marketing, worker deployment, and work visits. The five types are summarized in Table 1.

Industrial Apprenticeships

One key aspect of SMK St. Mikael's industry collaboration is its apprenticeship program, which provides students with hands-on experience in real-world settings. The school partners with companies that align with its vocational programs, specifically mechanical engineering and engineering drawing. During the program, students are closely monitored by both their teachers and company supervisors. This collaboration not only enhances the students' competence and work readiness but also keeps the schools updated on industry trends.

The research findings highlight the school's strategic approach to industry partnerships, with companies providing students with valuable guidance and feedback. At the end of the program, company supervisors evaluate student performance and provide feedback, which serves as a crucial input for the school to refine its curriculum and teaching methods. This continuous feedback loop enables SMK St. Mikael to improve graduate quality and stay responsive to industry needs.

Building on this industry-school collaboration, the apprenticeship program aims to enhance students' competence by immersing them in a real industrial environment. Fundamentally, as a part of the global TVET system (Guo & Wang, 2020), apprenticeships are realized by bringing manufacturing production into the classroom and extending learning into the factory. This approach, involving partnership among employers or companies, students, and educational institutions (International Labour Organization, 2020), fosters a mutual learning relationship between educational institutions and industry, providing students with valuable pre-working experience. Specifically for the students, the apprenticeship program is an excellent way to learn a career while ensuring an appropriate entry into the labor market (Smith, 2023), as they acquire practical experience. While for school and teachers, they benefit from staying updated on industry demands and developments, and from informing their teaching methods to better prepare students for the workforce.

The company partners also receive numerous advantages by partnering with the students' apprenticeship program. They can bridge the gap between competent workers and competent students. Not only in terms of knowledge, but apprenticeships are significant for students' overall personality development, as well as their beneficial and long-term impact on their job trajectories (Ertelt et al., 2021). By

participating in the program, students gain valuable experience in a real working environment, which enhances their labor skills. It's no surprise, then, that Vocational High School (VHS) graduates are often considered to have strong labor skills compared to those from general schools (Pritadrajati, 2022).

Apprenticeship of Productive Teachers

The second program is an apprenticeship for teachers who teach productive subjects at SMK St. Mikael. The informants conveyed that SMK St. Mikael uses the opportunity for cooperation offered by the Vocational School Education Board of Surakarta to give training for teachers of productive subjects. The program is conducted every three months, in which the teachers are sent to some companies, polytechnics, or enterprises.

This program is intended to promote teachers' competence and introduce them to the latest teaching equipment. The machines and tools of production used in companies or factories are generally more modern compared to those at schools. As a consequence, to apply what the teachers have learned at the apprenticeship program, the school should have similar machines and tools to enable the students to work well with the equipment in the future. For the best practice of using the equipment, the management of SMK St. Mikael will send their productive teachers to companies and let them try to recognize and operate the latest equipment.

The management of SMK St. Mikael believes that apprenticeships and training can enhance teachers' knowledge, competence, and skills, benefiting both teaching and managing the school's production unit. This aligns with research suggesting that TVET teachers need ongoing upskilling and retraining, with a focus on hands-on activities and integrating theory and practice (Magagula & Awodiji, 2024). Such upskilling and retraining should be conducted continuously, as TVET teachers necessitate comprehensive competency in order to respond to the exponential societal shift brought about by this era (Diao & Qu, 2024).

The school management's initiative to send teachers for apprenticeships facilitates technological transfer from companies and potential investment, ultimately benefiting the school. This approach aligns with research highlighting the impact of teacher training on student and institutional outcomes, as well as changes in cognition and behavior (Zhou et al., 2022). By linking school-taught competencies to industry demands, SMK St. Mikael addresses vocational school challenges in enhancing teacher quality and competence. To sustain this momentum, ongoing training and professional development are essential, as emphasized by research advocating for more frequent and intensive training for TVET educators (Eze et al., 2022).

Product Marketing

The third program, product marketing, enables the school production unit to accept orders from industrial companies and individuals. These orders, occasionally received from PT. ATMI or other companies are then executed by students in the production unit. This program aims to train students in producing goods via job orders and selling them to a broader market.

The observations and interviews reveal that student practicum generates products meeting school needs, company orders, or individual requests. At SMK St. Mikael, job orders are integrated into grade XII production practice, with job sheets tailored to product requests. The vice principal of curriculum and vocational program head, assisted by productive teachers, manages the practicum, leveraging the block schedule to align with industry needs.

To succeed in this program, effective order handling is crucial, and the teaching factory coordinator, who doubles as the marketing division head, plays a vital role in fostering communication and collaboration with customers. Effective communication with customers is vital, requiring immediate attention to ensure successful product promotion. This approach is well-timed, given students' nurtured competence, knowledge, and skills.

With the teacher's guidance in managing orders and production, the students gain practical experience in producing goods and interacting with clients. In this context, TVET teachers have a role to encourage the students to develop entrepreneurial abilities (Kolho, 2024). This hands-on experience enables students to develop essential skills in production planning, quality control, and customer service. To equip the students with effective order management, entrepreneurial education (EE) is needed, where the teachers are expected to deliver crucial business foundation and skills (Mack et al., 2024). EE has a favorable influence on both students' entrepreneurial expectations and mentality (Handayati et al., 2020), which will influence students' success in their job.

Worker deployment

The fourth program, worker deployment, allows SMK St. Mikael to link graduates with prospective companies via a job fair. The school invites organizations to give presentations to students about their organization and staffing needs. The job fair normally lasts three days, with the first two days allocated to company presentations and the third day scheduled for recruitment tests such as written exams, medical check-ups, interviews, and direct competency tests such as AutoCAD.

The job fair addresses a gap between students' career targets and companies' recruitment requirements.

Some students look for work immediately after graduation, and employers frequently look for new graduates to fill vacant positions. SMK St. Mikael supports this relationship by organizing job fairs, which help students move into the field and meet industry criteria. This program eventually links the students to the workforce (Lee et al., 2020) and serves as a platform for students to explore career alternatives and for employers to locate qualified people (Goller et al., 2025), linking the students to the workforce.

Graduates from SMK St. Mikael receive great demand from manufacturers, injection molding firms, and production machining enterprises. The majority of enterprises are based in Jakarta, Bogor, Depok, Tangerang, Bekasi, and Surabaya. Indeed, approximately 20-25% of vocational high school graduates immediately begin working; the rest pursue higher education, particularly at ATMI Solo, and only one or two persons become entrepreneurs. However, due to a limited number of graduates, the school sometimes struggles to meet the quantity demand. The significant demand for SMK St. Mikael alumni demonstrates the school's commitment to providing relevant, high-quality vocational education for the workforce. By emphasizing practical skills and industry connections, the school ensures that its students are well-prepared to satisfy employers' expectations. This fact implies that the school curriculum's alignment with the workforce demand is pivotal (Edeigba, 2022) so that students might enter the workforce confidently.

Industrial Work Visit

The fifth program is work visits for the students. SMK St. Mikael organizes work visits to several industrial companies that are linear with the vocational programs they have. During the activity, the students are introduced to the most modern machines used in companies. They also have a chance to identify what competence or skills are needed to operate the equipment and work with people in real industrial companies.

Furthermore, the companies they visit frequently give aid to schools in the form of practicum materials or even recommendations for the school to develop their curriculum for an up-to-date trend in industrial companies and upgrade their graduate qualifications. The company offers input to the school to ensure that the school keeps up with technological advancements and the skills required by the company. For example, consider the use of the 3D software. Even providing students with solid certification to prepare them for work.

From all the data collected, it was found that the work visits are strategically organized at companies that

align with SMK St. Mikael's vocational programs, with the primary goal of familiarizing students with cutting-edge industrial machinery and practices. This initiative is crucial, as research suggests that work visits significantly enhance students' practical understanding, thinking skills, and ability to apply knowledge in real-world settings (Suud et al., 2024). Moreover, industrial visits have been shown to boost student interest in class material and support knowledge acquisition (González-Peña et al., 2021), underscoring the value of this program in preparing students for successful careers.

In addition, the work visit allows the students to identify and analyze skills and competencies needed to work together with people in an industrial company, for instance, methodological, personal, and social competence. These three competencies are crucial for students to survive in their workplace in the future. This agrees with Chaka (2020), outlining that soft and hard skills are emphasized when facing and competing in Industry 4.0. Another report suggests that students will need 21st-century skills to succeed in their careers (Nuryanto & Eryandi, 2020; The Global Citizen Academy, 2021).

Industrial work visits not only facilitate students to learn from the real workforce, but they can also be a partner for the school. They may assist the school by providing suggestions or feedback for curriculum development (Valiente Bermejo et al., 2022), being an advisory board member, project sponsor, guest teachers at the school to share the experience they have gained while working at industrial companies, or even giving scholarships to the students to continue their studies at a higher education institution, such as a polytechnic or university. By leveraging these partnerships, SMK St. Mikael can ensure its programs remain industry-relevant and effective. Ultimately, this collaboration benefits students, the school, and industry partners, fostering a mutually supportive ecosystem.

Recruitment and industrial work visits support teaching factories in several ways. These initiatives help build relationships with companies or industries, providing students with valuable connections and opportunities. By gaining insight into daily life in a company, students become truly ready to work later, having a clearer understanding of what to expect. Joining these programs pertains to enhancing and broadening the students' views of their professional work and identity (Carbone et al., 2020) in their future. Additionally, companies may order specific products or goods from schools, thereby increasing their customer base. Furthermore, schools can adopt technologies used by companies or industries, enhancing their teaching and learning capabilities. This collaboration ultimately benefits both students and schools, preparing the next generation of workers and fostering innovation.

On the whole, among the four programs of industrial partnerships, apprenticeships are perceived to be the most effective in the area of advancing students' vocational competency. First, the students are directly involved in the workplace situation and culture, so they get accustomed to the professional environment. Second, they participate actively in using equipment with the latest technology. By doing this, they will not be left behind in the trend of their future job. As highlighted by Ebekozien et al. (2024), such a program will assist students with skills advancement, overcoming gaps between theory and practice, bridging skills gaps, and integrating learning into work.

Conclusion

The implementation of the TEFA model at SMK St. Mikael has yielded significant benefits, including the development of students' technical, methodological, social, and personal competencies. The school's production unit, managed professionally like an industrial company, provides students with hands-on experience in producing goods and services. The partnerships between the school and industrial companies have been instrumental in providing opportunities for student apprenticeships, teacher training, product marketing, worker deployment, and work visits. The success of the TEFA model at SMK St. Mikael has important implications for vocational education. It demonstrates that integrating school learning and industrial practice can produce qualified and competent workers who are ready to enter the workforce. The model's emphasis on industry partnerships and professional management can be applied to other vocational schools to enhance student outcomes and industry relevance. More specifically, the use of the block schedule and job sheet in the production unit, along with various activities in industrial partnerships, could be a model for other VHS to connect the lesson and the real industry world. However, this study is limited to some extent. This study was conducted at SMK St. Mikael, Surakarta, Central Java, Indonesia, which may limit the generalizability of the findings to other contexts. Therefore, further research is expected to be conducted in other areas to enrich the research results and provide a more comprehensive understanding of the TEFA model's effectiveness. Despite this limitation, the findings of this study suggest that educational policymakers and stakeholders should consider implementing TEFA models in vocational schools. Further research is needed to investigate the impact of TEFA on specific competencies required in the Industry 4.0 era and to identify best practices for implementing TEFA in different contexts. By exploring

the potential of TEFA, vocational education can be transformed to meet the needs of industry and prepare students for success in the modern workforce.

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Author Contributions

First Author: Designed the research design, conducted in-depth interviews, analyzed the data, and wrote the main report. Second Author: Conducted content analysis, assisted in interview transcription, and provided input into data analysis and interpretation. Third Author: Researched relevant literature, provided input to the research design, and assisted in writing specific chapters (e.g., literature review chapter).

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Conflicts of Interest

The authors declare no conflict of interest.

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