


Optimizing educational personnel for effective teaching factory implementation in vocational schools: A case study

Alexius Dwi Widiatna*  <https://orcid.org/0000-0002-1307-9382>
Natalis Sukma Permana  <https://orcid.org/0000-0001-6874-1348>

Theology Education Study Program, STKIP Widya Yuwana Madiun, Indonesia

ABSTRACT

There is a growing need to enhance the alignment between vocational education and industry requirements, yet research on the role of educational personnel management in optimizing teaching factory implementation remains limited. This study explores the management of educational personnel in the implementation of teaching factories as an innovative learning model. A teaching factory represents a dynamic and practical learning environment designed to integrate educational processes with industrial practices, bridging the gap between the competencies of students in vocational schools and the demands of industry for skilled workers. The research employs a qualitative approach using a case study method. Data were gathered through observation, participatory observation, documentation, and in-depth interviews with key stakeholders, including the principal, the head of personnel, and the heads of expertise programs. Data analysis involved processes of data condensation, data display, and conclusion drawing. The findings demonstrate that St. Mikael's approach to educational personnel management is both innovative and effective. By investing in teacher development, fostering collaboration, and addressing challenges proactively, the school has created an environment where both teachers and students thrive. These strategies not only enhance the competencies of educators but also prepare students to meet the demands of the modern workforce. The insights from this study provide valuable lessons for other vocational schools aiming to implement teaching factory models and align education with industry needs.

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Introduction

Vocational education serves as a critical pillar in preparing students for the workforce, equipping them with specialized skills and competencies aligned with the demands of specific industries. Graduates of vocational high schools are expected to possess mid-level technical proficiencies that make them workforce-ready, thus meeting the expectations of businesses and industries (McGrath & Ramsarup, 2024; Ye et al.,

* Corresponding author: Alexius Dwi Widiatna  alexius.widiatna@widayuwana.ac.id

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2024). However, vocational schools face significant challenges, particularly in the availability and quality of educational personnel capable of enhancing student competencies effectively (Kovalchuk et al., 2022). Traditional teaching practices, which often emphasize one-way information delivery, limit students to passive roles and fail to align with the dynamic needs of the industrial sector (Ravichandran & Mahapatra, 2023). Consequently, there exists a significant gap between the competencies taught in vocational schools and the actual requirements of the labor market.

To address these challenges, vocational education institutions must revitalize their approaches by focusing on the competence development of educational personnel. One innovative solution is the implementation of a teaching factory, a systematic and integrative model that blends the educational and industrial environments (Azizah et al., 2019; Kautsar et al., 2022; Mourtzis et al., 2023). This approach fosters real-world learning by replicating industrial processes within an educational setting (Mourtzis et al., 2021). By simulating "factory-like" conditions, teaching factories bridge the gap between theoretical learning and practical application, enabling students to acquire the professional, methodological, social, and personal competencies essential for employment (Mavrikios et al., 2018). This innovative model also supports the development of student competencies in a manner that is directly relevant to industry needs, thus enhancing their employability.

Teaching factories have gained traction in vocational education globally as an effective means to integrate classroom learning with real-world industrial practices. By offering hands-on experiences, these environments foster technological and organizational innovation, contributing to enhanced student outcomes (Imran et al., 2024; Sutianah et al., 2024). Numerous studies have emphasized the importance of aligning vocational education with industry standards to produce competent graduates who can meet market demands. For instance, Wahjusaputri et al. (2024) highlight the transformative potential of teaching factories in bridging educational and industrial practices, while Hatmojo and Ikhsannudin (2024) highlighted their effectiveness in fostering competency development through authentic learning environments. Despite these advancements, gaps remain in the effective management of educational personnel, which is critical for the successful implementation of teaching factories.

Effective educational personnel management is a cornerstone of successful vocational education. Principals and school leaders play pivotal roles in ensuring the recruitment, training, and professional development of teachers, aligning their competencies with the evolving demands of teaching factory models (Djuhartono et al., 2021). Research indicates that educational staff management encompasses several key functions, including employee planning, training, evaluation, and the provision of incentives (Martawijaya, 2012; Suhartini, 2022). Competent teachers are instrumental in facilitating the transition from traditional teaching methods to innovative models such as teaching factories. As highlighted by (Islami et al., 2021), continuous professional development and collaborative teamwork are essential for equipping teachers with the skills necessary to implement these advanced educational frameworks.

The role of school leadership in fostering teacher competence is particularly critical in vocational schools. Principals must not only ensure the availability of qualified teachers but also create a supportive environment that encourages innovation and professional growth (Gumilar & Ridwan, 2024; Hidayati & Mayasari, 2020). This includes facilitating collaboration among teachers, building networks with industry partners, and implementing structured professional development programs (Rustomo et al., 2024). The success of teaching factory models hinges on the ability of teachers to deliver practical, industry-relevant learning experiences. As Mahlangu and Mtshali (2024) emphasize, the quality of education in vocational schools is largely determined by the competence and motivation of their teaching staff.

The concept of the teaching factory originated in the United States in the 1990s, inspired by the medical school-hospital model, where learning occurs in a real-world

environment. Teaching factories adapt this paradigm to technical and vocational education by integrating classroom learning with industrial practices (Chryssolouris et al., 2016; Mavrikios et al., 2018). This approach has since evolved to include the "factory-to-classroom" model, which aims to transfer the industrial environment into the educational setting (Puspita et al., 2020). By replicating real production processes, teaching factories provide students with opportunities to apply theoretical knowledge in practical scenarios (Rohaeni et al., 2021), thereby bridging the gap between education and industry. This model not only enhances student competencies but also fosters innovation and collaboration between educational institutions and industry partners.

Despite the growing adoption of teaching factories, limited research has been conducted on the specific management practices required for their successful implementation. This study addresses this gap by examining the management of educational personnel in the context of teaching factories at Catholic Vocational High School of St. Mikael Surakarta. Unlike previous studies that primarily focus on the technical aspects of teaching factories, this research explores the organizational and managerial dimensions, particularly the strategies employed by school leaders to enhance teacher competence and align educational practices with industry standards. The novelty of this study lies in its focus on integrating teaching factories into the curriculum and teaching processes, rather than treating them as standalone initiatives. By adopting a qualitative case study approach, this research provides an in-depth analysis of the unique practices and challenges faced by Catholic Vocational High School of St. Mikael in implementing teaching factories. The findings of this study are expected to contribute to the development of effective management strategies for vocational education, offering valuable insights for policymakers, educators, and researchers.

This research aims to achieve the following objectives: first, to explore the strategies employed by Catholic Vocational High School of St. Mikael in managing educational personnel for teaching factory implementation; second, to identify the challenges and opportunities associated with these strategies; and third, to provide actionable recommendations for improving teacher management practices in vocational schools. The study is guided by three following research questions. By addressing these questions, this research aims to bridge the gap between theoretical knowledge and practical application in vocational education, contributing to the broader discourse on educational innovation and workforce development. Through its focus on teaching factory-based management practices, this study seeks to enhance the quality and relevance of vocational education, ultimately benefiting students, educators, and industry stakeholders alike.

- 1) What are the key strategies employed by Catholic Vocational High School of St. Mikael in managing educational personnel for teaching factory implementation?
- 2) How do these strategies impact the competencies of teachers and students?
- 3) What challenges and opportunities arise in the implementation of teaching factories, and how can they be addressed?

Method

This study utilized a qualitative approach with a case study design to explore the effective management of educational personnel in implementing teaching factories at the Catholic Vocational High School of St. Michael, Surakarta municipality, Indonesia. The case study method was chosen due to the unique and exemplary implementation of the teaching factory at this school, addressing the core questions of how and why this model is applied. The rationale for this design lies in its ability to provide an in-depth understanding of complex phenomena within their real-life context, as emphasized by Yin (2015). In the context of this study, this approach allows for a comprehensive exploration of the management practices and their impacts on student competency development. The participants included key internal stakeholders, i.e., the Chairperson of the Karya Bhakti Foundation, the principal, the Head of Personnel (HRD) at the Deputy Principal level, and

the Head of Quality Management Representative (QMR) at the Deputy Principal level. External participants included teachers and students from other vocational schools conducting comparative studies. This diverse range of informants ensured a holistic understanding of the teaching factory implementation within the school's ecosystem.

Data collection employed multiple methods, including documentation, archival records, in-depth interviews, direct and participant observation, and physical artifact analysis. Dominantly, the researcher conducted in-depth interviews with informants and engaged in participant observation over eight weeks, immersing themselves as trainees to experience the teaching factory environment firsthand. This immersive approach captured not only observable practices but also the researcher's reflections and experiences, enriching the data's authenticity and depth (Lichtman, 2023). Furthermore, data analysis was conducted by following the framework of Miles and Huberman (Huberman & Miles, 2002), involving three concurrent activities: data condensation, data display, and conclusion drawing or verification. This iterative process was conducted before, during, and after fieldwork to ensure comprehensive insights. To enhance the study's validity, credibility was ensured through triangulation, transferability through detailed contextual descriptions, dependability through systematic processes, and objectivity through reflexive practices.

Results

This study explores the educational personnel management at the Vocational High School of St. Mikael, which implements a teaching factory model. The findings are presented in three subsections based on the research questions: (1) key strategies for managing educational personnel, (2) the impact of these strategies on teacher and student competencies, and (3) challenges and opportunities in teaching factory implementation. The presentation of the findings below is accompanied by direct quotations from the participants obtained through semi-structured interviews.

Key Strategies for Managing Educational Personnel

The management of educational personnel at St. Mikael is based on a systematic approach that enhances teacher competence and aligns teaching practices with industrial standards. The school conducts regular performance assessments to evaluate teachers' abilities and commitment, rewarding those with exceptional performance through professional development opportunities. The head of personnel (HRD) explained:

"We evaluate teachers not only on their teaching skills but also on how well they embody the school's values and goals. Those who excel are sent for further training, such as apprenticeships in reputable companies or international training programs. These opportunities ensure that our teaching staff remain relevant to industry needs and maintain high standards in the classroom."

The chairperson of the Karya Bhakti Foundation elaborated on the importance of aligning teacher development with the institution's mission:

"Our teachers are not just educators; they are mentors who inspire students to achieve excellence. By investing in their growth, whether through training or further studies, we ensure they can transfer that excellence to their students. This is why we prioritize sending them to industry-leading programs and creating opportunities for their continuous improvement."

Recruiting graduates of St. Mikael as teachers is another key strategy. By hiring alumni, the school ensures new teachers already share its vision, values, and technical expertise. This aligns with the concept of organizational socialization, where employees familiar with the institution's culture are more likely to contribute effectively. Furthermore, the school prioritizes competency training through local and international programs. For example, productive teachers participate in workshops hosted by the Solo Education Office or attend specialized training sessions in Japan and Australia. Such programs are instrumental in keeping teachers updated on technological advancements and equipping them with real-world knowledge that enriches their teaching practices. The school principal highlighted the importance of international training programs:

"We believe that exposure to global practices is essential for our teachers. Programs in Japan and Australia give them access to advanced technologies and innovative teaching methods. When they return, they bring a wealth of knowledge that directly benefits our students and aligns our curriculum with international standards."

Practical teachers are also regularly sent to companies for three-month industrial apprenticeships. These apprenticeships provide hands-on exposure to industry practices, enabling teachers to master advanced machinery and techniques. Upon returning, they incorporate this knowledge into the school's curriculum, bridging the gap between theoretical education and industrial demands. One teacher noted:

"My time in the company was transformative. I learned how to operate complex machinery and gained insights into production workflows. Bringing these experiences back to the classroom has allowed me to make lessons more practical and relevant for students."

The implications of these strategies are significant. First, they establish a culture of excellence and accountability among teachers, fostering a professional environment where continuous improvement is valued. Second, they enhance the school's capacity to adapt to industry trends, ensuring that students receive an education that prepares them for the workforce. Finally, by aligning teacher development with institutional goals, St. Mikael creates a cohesive and effective educational framework that can serve as a model for other vocational schools. However, these initiatives also require substantial investment in terms of time, resources, and institutional support. The school must therefore maintain strong partnerships with industry and government agencies to sustain these programs. These findings suggest that systematic and well-resourced teacher management practices are critical for the success of teaching factory models, as they directly impact both the quality of education and student outcomes.

Impact of Strategies on Teacher and Student Competencies

The strategies employed at St. Mikael have significantly improved the competencies of both teachers and students. Teachers have become proficient in integrating industrial practices into their lessons, making their teaching more practical and relevant. A practical teacher shared their experience:

"The training I received in Japan exposed me to cutting-edge production methods and industrial culture. When I returned, I was able to incorporate these insights into my lessons. This not only improved my teaching but also made the learning process more engaging for students. They are now better prepared to meet the demands of the workforce."

Another teacher emphasized the value of industrial apprenticeships in shaping their teaching approach:

“Spending time in a real production environment allowed me to see how theories translate into practice. It also helped me understand what industries expect from our students. This perspective has been invaluable in designing lessons that truly prepare students for their careers.”

The head of the Quality Management Representative (QMR) highlighted how these strategies reinforce institutional goals:

“Our continuous efforts to integrate industrial standards into teaching not only improve teacher competencies but also ensure that students graduate with skills that are immediately applicable. This alignment between curriculum and industry expectations has significantly enhanced our school’s reputation among employers.”

The deputy principal elaborated on the student benefits:

“Our students not only learn technical skills but also develop critical soft skills, such as teamwork and communication, through their exposure to industrial culture. These competencies are indispensable in today’s workforce and set our graduates apart from their peers.”

The impact on students is equally remarkable. By learning in a factory-like environment, students acquire technical and soft skills essential for their future careers. They gain hands-on experience with advanced machinery under the guidance of teachers who have firsthand industrial expertise. A recent graduate noted:

“Our training at school feels like working in an actual factory. The machines, the discipline, and even the teamwork are exactly what I encountered during my internship. This experience made my transition to the workplace much smoother.”

The school instills an industrial culture among students, emphasizing discipline, responsibility, and adherence to procedures. This prepares them for the professional world and enhances their employability. Employers often remark on the high competency levels of St. Mikael’s graduates, attributing this to the practical and values-driven education they receive. One employer stated:

“Graduates from St. Mikael stand out because they are not just technically skilled but also highly disciplined and professional. It’s clear that the school goes beyond teaching technical knowledge and focuses on holistic development.”

These improvements in teacher and student competencies highlight the effectiveness of the teaching factory model. By closely aligning educational practices with industry requirements, St. Mikael ensures that its graduates are well-prepared to contribute to the workforce. Moreover, the emphasis on values and discipline fosters a strong work ethic, making graduates highly desirable to employers.

Challenges and Opportunities in Teaching Factory Implementation

While the teaching factory model at St. Mikael has been largely successful, it also faces several challenges. Resource limitations, the rapid pace of technological advancements, and the need to balance theoretical and practical learning are among the key issues. A senior teacher noted:

“One of our biggest challenges is keeping up with technological changes. Machinery becomes obsolete quickly, and replacing it requires significant investment. However, our partnerships with industry help us bridge this gap by providing access to modern equipment and expertise.”

Another teacher highlighted the challenges of balancing theory and practice:

“Sometimes, ensuring that students fully grasp theoretical concepts while maintaining practical skill development is tough. We need to ensure both components are seamlessly integrated, which requires careful planning and collaboration among teachers.”

The school principal elaborated on the broader challenges of resource management:

“Our limited budget often forces us to prioritize which equipment to upgrade. While we strive to provide state-of-the-art tools, we must also rely on industry collaborations to bridge the gap. These partnerships are vital for sustaining the teaching factory model.”

The chairperson of the Karya Bhakti Foundation highlighted the opportunities these challenges present:

“Challenges push us to innovate. Our partnerships with industry are not just about equipment—they’re about exchanging knowledge and ensuring our curriculum stays relevant. This collaboration strengthens our reputation and prepares our students for an ever-evolving job market.”

Despite these challenges, the school has identified opportunities for growth and innovation. Collaborations with industry partners allow the school to access cutting-edge technology and receive valuable input on curriculum development. These partnerships also enhance the reputation of the school within the community, strengthening its ties with local stakeholders. An industry partner commented:

“Our collaboration with St. Mikael has been mutually beneficial. We provide insights into the latest industrial practices, and in return, we get graduates who are exceptionally well-prepared for the workforce. It’s a win-win relationship.”

Another opportunity lies in fostering a culture of continuous improvement among teachers. By encouraging lifelong learning, the school ensures that its teaching staff remain adaptable and capable of meeting new challenges. Teachers collaborate across disciplines to integrate theoretical and practical components into the curriculum. For example, English and practical teachers work together on project-based learning to help students develop both technical and communication skills. A teacher explained:

“Teamwork is essential in our teaching factory. When we collaborate, we ensure that students receive a well-rounded education. For instance, we jointly assess projects to ensure they meet both technical and communication standards. This approach prepares students for real-world scenarios where interdisciplinary collaboration is key.”

The challenges and opportunities encountered in the teaching factory model highlight the dynamic nature of vocational education. While resource constraints and technological advancements present hurdles, they also drive innovation and

collaboration. By leveraging partnerships and fostering a culture of adaptability, St. Mikael continues to evolve and set a benchmark for vocational education.

Discussion

This study explores the management of educational personnel in implementing the teaching factory model at the Vocational High School of St. Mikael. The findings provide insight into key strategies employed by the school, the impact of these strategies on teachers and students, and the challenges and opportunities in the teaching factory's implementation. This discussion contextualizes the findings within relevant theories and previous studies, critically analyzing their implications.

The findings reveal that St. Mikael's systematic approach to managing educational personnel is pivotal in aligning teaching practices with industrial standards. The school's strategy of conducting regular performance assessments and rewarding high-performing teachers with professional development opportunities demonstrates alignment with [Schuler and Jackson's \(2014\)](#) model of effective human resource management. Performance assessments not only ensure accountability but also cultivate a culture of continuous improvement ([Legge, 2014](#)). The emphasis on aligning teacher development with institutional goals is consistent with the organizational socialization theory ([Moyson et al., 2018](#)), which posits that employees who are integrated into their institution's culture perform better and contribute more effectively.

In the context of this study, St. Mikael's practice of recruiting alumni as teachers also reflects strategic foresight. By hiring graduates who already share the school's vision and technical expertise, the school minimizes the cultural adjustment period for new recruits. This strategy is supported by research from [Azizah et al. \(2019\)](#), who found that shared cultural and institutional knowledge enhances professional collaboration and effectiveness. Moreover, sending teachers for industrial apprenticeships and international training aligns with the concept of professional learning communities, where teachers continuously acquire and apply new knowledge to improve practice ([Qutni et al., 2021](#)).

However, while the strategies are effective, they are resource-intensive. The need for significant investment in training programs and industrial partnerships presents a sustainability challenge ([Suhartini, 2022](#)). This limitation calls for stronger collaboration with industry and government to subsidize these initiatives ([Fattah et al., 2021](#)). The findings also highlight the importance of integrating lifelong learning principles into teacher training, as emphasized by ([Mavrikios et al., 2018](#)). Theoretical contributions from this study suggest that strategic alignment of teacher development with institutional goals can enhance both teacher performance and student outcomes, supporting the broader implementation of teaching factory models.

The implementation of the teaching factory model has significantly improved the competencies of teachers and students. Teachers at St. Mikael have become adept at incorporating industrial practices into their lessons, reflecting Kolb's experiential learning theory ([Morris, 2020](#)), which emphasizes learning through experience. By participating in industrial apprenticeships, teachers gain firsthand knowledge of production processes, enabling them to design lessons that bridge the gap between theory and practice ([Conner, 2022](#); [Falloon, 2019](#)). This approach not only enriches their teaching but also ensures that students are equipped with relevant skills.

The impact on students is particularly noteworthy. By learning in a factory-like environment, students acquire both technical and soft skills essential for the workforce. This aligns with the findings of [Mavrikios et al. \(2018\)](#) who argue that authentic learning environments, such as teaching factories, enhance students' ability to transfer skills to real-world contexts. The integration of discipline, responsibility, and adherence to industrial procedures into the school culture prepares students for professional settings ([Wahjusaputri et al., 2024](#)). Employers' recognition of St. Mikael's graduates as highly

competent and disciplined further underscores the effectiveness of this model. The findings also reveal that project-based learning, supported by interdisciplinary collaboration among teachers, enhances students' holistic development. For instance, the integration of English and practical skills helps students articulate technical processes effectively, a competency often overlooked in traditional vocational education (Hatmojo & Ikhsannudin, 2024). This resonates with constructivist theories of learning, which emphasize the importance of contextually rich and socially interactive environments (Tan & Ng, 2021).

While these strategies significantly enhance competencies, their success depends on sustained teacher engagement and industry collaboration. Teachers' motivation to continually update their skills is crucial for maintaining the relevance of the teaching factory model (Kautsar et al., 2022). Furthermore, the findings imply that vocational schools must balance skill-specific training with the development of transferable competencies, such as problem-solving and communication, to prepare students for evolving labor market demands. Despite its successes, the implementation of the teaching factory model at St. Mikael faces notable challenges. Resource limitations, particularly in maintaining up-to-date machinery, highlight the financial demands of aligning educational infrastructure with industrial standards. This finding aligns with the challenges identified by Gustiar et al. (2021) who noted that vocational schools often struggle to keep pace with technological advancements due to budget constraints. However, the study also emphasizes the role of industry partnerships in mitigating these challenges. By collaborating with companies, St. Mikael gains access to modern equipment and expertise, enabling it to provide students with a current and practical education.

The rapid pace of technological change presents another challenge. Teachers must constantly adapt their knowledge and skills to stay relevant, requiring sustained professional development efforts. This aligns with the concept of adaptive expertise (Kua et al., 2021), which emphasizes the need for professionals to continually refine their skills to meet new challenges. St. Mikael's approach to fostering a culture of lifelong learning among teachers addresses this need, but it also requires ongoing institutional and financial support. Opportunities for innovation and growth are also evident in the findings. The school's emphasis on interdisciplinary collaboration among teachers fosters a more integrated and holistic educational experience for students. This approach aligns with the principles of team teaching, which have been shown to improve student outcomes by combining diverse expertise (Martawijaya, 2012). Additionally, the school's partnerships with industry and community stakeholders enhance its reputation and expand its resources, creating a mutually beneficial relationship that supports both educational and industrial objectives.

The findings of this study have both theoretical and practical implications. Theoretically, they contribute to the growing body of literature on teaching factory models and their role in bridging the gap between education and industry. By demonstrating how strategic management of educational personnel enhances teacher and student competencies, the study provides a framework for understanding the interplay between institutional strategies and educational outcomes. This framework can inform future research on vocational education and workforce development, particularly in contexts where alignment with industry standards is critical. Practically, the findings offer actionable insights for policymakers, educators, and industry stakeholders. For policymakers, the study underscores the importance of supporting vocational schools through funding and policy initiatives that facilitate industry collaboration and teacher development. For educators, it highlights the value of integrating experiential learning, interdisciplinary collaboration, and continuous professional development into their practices. Finally, for industry stakeholders, the study demonstrates the mutual benefits of partnering with vocational schools to create a skilled and industry-ready workforce.

Conclusion

This study highlights the effective management of educational personnel in the implementation of a teaching factory model at the Vocational High School of St. Mikael. The findings reveal that strategic approaches—such as performance assessments, targeted recruitment, and continuous professional development—enhance teacher competencies and align teaching practices with industrial standards. These strategies significantly impact student outcomes by fostering technical and soft skills, embedding industrial culture, and preparing students for the workforce. The study also underscores the importance of interdisciplinary collaboration and industry partnerships in overcoming challenges such as resource limitations and the rapid pace of technological advancements. The findings suggest that adopting a systematic and collaborative approach to managing educational personnel can serve as a model for vocational schools aiming to bridge the gap between education and industry, ultimately contributing to the development of a skilled and adaptable workforce.

Despite its contributions, this research has certain limitations. The study is based on a single case study, limiting the generalizability of the findings to other vocational schools with different contexts or resources. Additionally, the reliance on qualitative methods, while providing depth, does not quantify the broader impact of the strategies on student employability or teacher performance. Future research should explore the implementation of teaching factory models across diverse institutional settings, incorporating mixed methods to provide both qualitative and quantitative insights. Practical suggestions for future studies include examining the long-term sustainability of industry partnerships, the scalability of teaching factory models, and the role of emerging technologies in enhancing vocational education. By addressing these areas, future research can build on the findings of this study to further advance the field of vocational education and workforce development.

Authors' Declaration

The authors made substantial contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation and discussion of results. The authors read and approved the final manuscript.

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