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Managing Teaching Factory Programs to Strengthen Student Competence: Evidence from Two Indonesian Vocational High Schools

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Abstract:
This study examines how the Teaching Factory is implemented to enhance student competence at SMK Negeri PP Cianjur and SMK Negeri 1 Cugenang, Indonesia. The study employed a qualitative multiple-case study design. Data were collected through in-depth interviews, direct observations, and document analysis involving school principals, vice principals, vocational teachers, students, and representatives of business and industry partners. Data were analyzed using the interactive model of data condensation, data display, and conclusion drawing. Trustworthiness was ensured through source triangulation, method triangulation, member checking, and repeated observations. The findings show that Teaching Factory was implemented through production-based learning activities that engaged students in work planning, preparation of materials and equipment, task allocation, production processes, quality control, packaging, and product completion. The program contributed to the development of students' technical skills and professional work attitudes, including discipline, responsibility, teamwork, accuracy, and awareness of quality standards. The findings also indicate that effective implementation depended on integrating planning, organizing, implementing, and evaluating functions, supported by teacher commitment, school leadership, production facilities, and industry collaboration. However, limited facilities, uneven teacher industrial experience, variations in student readiness, and limited industry involvement in assessment and program development remained key challenges. This study's novelty lies in analyzing Teaching Factory through an educational management perspective across two vocational contexts. The study highlights the importance of strengthening management systems, teacher professional development, industry partnerships, and industry-based assessment to sustain Teaching Factory implementation and improve vocational student competence.

Keywords: Educational Management; Industry Partnership; Production-based Learning; Student Competence; Teaching Factory; Vocational Education.

Introduction

Vocational education plays a strategic role in preparing competent, adaptable, and work-ready human resources. Vocational High Schools (*Sekolah Menengah Kejuruan*/SMKs), as providers of vocational education in Indonesia, are expected to produce graduates who possess not only theoretical knowledge but also technical skills, professional attitudes, teamwork abilities, discipline, responsibility, and adaptability

to the changing demands of business and industry. In an increasingly competitive labour market and amid rapid technological development, the quality of SMK graduates has become an important indicator of the effectiveness of vocational education (Rohaeni et al., 2021; Wahjusaputri et al., 2024).

Vocational education fundamentally emphasises contextual, applied, and workplace-oriented learning. (Prosser & Allen, 1925) argued that vocational education is more effective when learning takes place in an environment that resembles actual working conditions. This principle suggests that learning in SMKs should extend beyond the acquisition of subject matter and isolated practical exercises. Instead, students need to gain comprehensive work experience, including work planning, the use of tools and materials, production processes, compliance with standard operating procedures, quality control, and evaluation of work outcomes.

From an educational management perspective, the success of the Teaching Factory depends heavily on the school's capacity to manage the programme systematically. Its implementation requires careful planning, effective organisation of resources, delivery of production-based learning, and evaluation of both processes and outcomes.(Dwikurniangsih, 2025) stated that the success of educational innovation is influenced by leadership, collaboration among stakeholders, institutional support, and continuous evaluation. In the context of the Teaching Factory, school principals, vocational teachers, students, administrative staff, production-unit managers, and industry partners play interconnected roles in creating learning experiences that conform to industrial work standards.(Dwikurniangsih, 2025; Rossa et al., 2025)

Previous studies have indicated that the Teaching Factory contributes positively to the improvement of vocational students' competencies. Gento found that Teaching Factory implementation improved students' work skills through learning experiences that resembled industrial settings (Gento et al., 2021). Similarly, Sutinah reported that production-based learning strengthened the connection between school-based learning and workplace demands (Sutianah et al., 2024). Rifai further explained that student participation in production processes can enhance work readiness by providing more authentic work experiences (Rifai et al., 2025). In addition, Pratama emphasised that the effectiveness of the Teaching Factory is influenced by learning management, teacher readiness, facilities, and partnerships with business and industry (Pratama et al., 2025).

Nevertheless, previous studies have also shown that Teaching Factory implementation in vocational schools is not always optimal. Many schools continue to face constraints related to inadequate production facilities, limited industry involvement, insufficient industrial experience among vocational teachers, and the incomplete integration of production activities into the learning process. In some cases, practical activities remain focused on conventional skills training and have not fully incorporated industrial workflows, production targets, quality-control procedures, and workplace culture. Such conditions may hinder the Teaching Factory from achieving its primary objective of developing students' work-related competencies comprehensively.

A preliminary study conducted at SMK Negeri PP Cianjur and SMK Negeri 1 Cugenang found that both schools had developed production-based learning in accordance with the characteristics of their respective vocational programmes. At SMK Negeri PP Cianjur, Teaching Factory activities were developed through agricultural and agricultural-product processing programmes. Meanwhile, SMK Negeri 1 Cugenang implemented Teaching Factory activities in food-processing programmes. In both schools, students were involved in preparing tools and materials, carrying out production processes, distributing work tasks, packaging products, and inspecting the quality of production outcomes.

However, the preliminary study also identified several issues in the implementation of the Teaching Factory at both schools. These issues include limited production facilities, variations in students' ability to comply with work standards, the readiness of vocational teachers to manage production-based learning, and the limited involvement of industry partners in programme development and student competency evaluation. Moreover, Teaching Factory implementation needs to be strengthened through more systematic management to ensure that production activities function not merely as practical exercises, but as meaningful learning processes that develop students' technical competencies and professional work attitudes.

These conditions indicate a research gap that requires further investigation. Previous studies have generally focused on the effectiveness of the Teaching Factory in improving students' skills, work readiness, learning outcomes, or general supporting and inhibiting factors. However, there remains limited research that comprehensively examines Teaching Factory implementation through the perspective of educational management functions, particularly across two vocational schools with different production-field characteristics. Differences in vocational programmes, school resources, industry partnership patterns, and student characteristics may lead to different patterns of Teaching Factory implementation.

Previous studies have consistently demonstrated the potential of Teaching Factory to improve vocational students' skills, work readiness, and the relevance of school-based learning to industrial demands. Gento et al. (2021) showed that Teaching Factory can strengthen students' work skills through learning environments that resemble industrial settings, while Sutianah et al. (2024) emphasised the role of production-based learning in connecting school learning with workplace demands. Similarly, Rifai et al. (2025) highlighted its contribution to students' work readiness. However, these studies have primarily examined Teaching Factory in terms of learning outcomes and student competence. Other studies, such as Pratama et al. (2025), have identified teacher readiness, facilities, learning management, and industry partnerships as important factors influencing programme effectiveness. Although these findings indicate that Teaching Factory outcomes are closely related to managerial and institutional conditions, these factors have generally been discussed as separate supporting or inhibiting variables rather than as interconnected educational management functions.

Consequently, a conceptual and empirical gap remains in understanding how planning, organising, implementing, and evaluating operate as an integrated management process in Teaching Factory implementation and how these processes contribute to student competence. This gap is particularly relevant because differences in vocational programmes, school resources, production characteristics, teacher capacity, and patterns of industry collaboration may produce different implementation practices. Comparative evidence across vocational schools with different production contexts also remains limited. Therefore, examining Teaching Factory through an educational management perspective across two different vocational settings is necessary to explain not only whether the programme contributes to student competence, but also how managerial processes shape its implementation, effectiveness, and sustainability.

The present study addresses this gap by analysing Teaching Factory implementation through four educational management functions—planning, organising, implementing, and evaluating—at SMK Negeri PP Cianjur and SMK Negeri 1 Cugenang. By comparing agriculture and agricultural-product processing with food-processing contexts, the study seeks to identify both common management patterns and context-specific implementation challenges. In this way, the study extends previous research by positioning Teaching Factory not merely as a production-based learning model, but as an integrated vocational learning

ecosystem involving school management, productive learning, industrial work culture, and partnerships with business and industry.

Literature Study

Teaching Factory is a vocational learning model that integrates instructional activities with production processes based on industrial procedures, standards, and work culture. Its effectiveness, however, depends not only on students' involvement in production activities but also on systematic educational management. In this study, educational management is conceptualised through four interconnected functions: planning, organising, implementing, and evaluating. Planning aligns learning objectives with production activities and industrial needs, while organising coordinates the roles of school leaders, teachers, students, resources, and industry partners.

Implementation translates these plans into authentic production-based learning experiences in which students prepare materials and equipment, carry out production tasks, follow standard operating procedures, control product quality, and complete production outputs. Through these activities, students develop technical skills as well as professional work attitudes such as discipline, responsibility, teamwork, accuracy, communication, and awareness of quality standards. Evaluation then assesses both student performance and product outcomes, providing feedback for improving learning and programme implementation.

Accordingly, the conceptual framework positions educational management functions as the mechanisms that shape the quality of Teaching Factory implementation, while Teaching Factory serves as the learning environment through which student competence is developed. The relationship can be understood as an interconnected cycle of planning, organising, implementing, and evaluating that contributes to stronger technical competence and professional work attitudes. This process may be strengthened or constrained by school leadership, teacher capacity, facilities, student readiness, and industry collaboration.

Methods

This study employed a qualitative approach using a multiple-case study design to explore the implementation of the Teaching Factory in enhancing student competence at SMK Negeri PP Cianjur and SMK Negeri 1 Cugenang, Indonesia. A qualitative case study was considered appropriate because it enabled an in-depth examination of Teaching Factory implementation within its natural school settings. The study focused on how the programme was planned, organised, implemented, and evaluated, as well as how it contributed to the development of students' technical competencies and professional work attitudes.(Adrias & Ruswandi, 2025; Creswell & Creswell, 2018; Stake, 1995; Yin, 2017)

The research was conducted from July to November 2025. The two schools were selected purposively because both had implemented production-based learning as part of their Teaching Factory programmes, although they operated in different vocational fields. SMK Negeri PP Cianjur implemented Teaching Factory activities in agriculture and agricultural-product processing, whereas SMK Negeri 1 Cugenang implemented the programme in food-processing activities. This variation enabled the study to compare implementation practices across different vocational contexts.

Participants were selected purposively based on their involvement in and knowledge of the Teaching Factory programme. The study involved five participants, consisting of one school principal, one vice principal, one vocational teacher, one student, and one representative of a business and industry partner. In-depth interviews were conducted individually and focused on programme planning, organisation, implementation, evaluation, student competence development, and industry collaboration. Observations

and relevant documents were used to complement and verify the interview data (Lincoln & Guba, 1985; Miles et al., 2014; Shenton, 2004; Tisdell et al., 2025).

Data were collected through in-depth interviews, direct observations, and document analysis. Interviews were conducted to obtain participants' perspectives on the management and implementation of Teaching Factory activities. Observations focused on students' participation in production-based learning, work division, compliance with standard operating procedures, quality-control practices, and interaction among teachers, students, and industry-related actors. Documents such as programme plans, organisational structures, standard operating procedures, production records, partnership documents, and learning evaluation reports were also analysed to strengthen the findings.

Data analysis followed the interactive model proposed by Miles, Huberman, and Saldaña (2014), consisting of data condensation, data display, and conclusion drawing and verification. The analysis was conducted continuously throughout the data-collection process. Data from interviews, observations, and documents were coded, categorised, and interpreted according to the study's main focus: planning, organising, implementing, and evaluating the Teaching Factory programme, as well as its contribution to student competence.

To ensure trustworthiness, the study applied source triangulation and method triangulation. Information obtained from school leaders, teachers, students, and industry partners was compared to identify consistency and differences across perspectives. Data from interviews were also cross-checked with observations and relevant documents. In addition, member checking was conducted by confirming selected findings with participants, while prolonged engagement and repeated observations were used to strengthen the credibility of the findings.

Results

Planning of the Teaching Factory Programme

The findings indicate that both SMK Negeri PP Cianjur and SMK Negeri 1 Cugenang had incorporated Teaching Factory activities into productive learning programmes. Programme planning was generally aligned with the characteristics of each school's vocational specialisation. At SMK Negeri PP Cianjur, the Teaching Factory was developed through agricultural production and agricultural-product processing activities. At SMK Negeri 1 Cugenang, the programme was implemented through food-processing activities. In both cases, planning involved the identification of learning objectives, preparation of tools and materials, scheduling of production activities, allocation of student tasks, and determination of expected products.

Observation results showed that the planning process was reflected in the preparation of production equipment, materials, student work groups, and practical learning schedules before production activities began. Teachers prepared learning activities by connecting practical tasks with the competencies targeted in productive subjects. However, the degree of planning documentation and production scheduling appeared to vary between the two schools. SMK Negeri PP Cianjur placed greater emphasis on the continuity of agricultural production cycles, whereas SMK Negeri 1 Cugenang focused more on the sequence of food-processing procedures and product preparation.

The findings suggest that Teaching Factory planning was not limited to lesson preparation, but also involved managing production activities as learning experiences. This indicates that the programme required teachers to integrate curriculum targets with production demands. Nevertheless, the findings also

show that planning still needs to be strengthened through more detailed production targets, written quality standards, market-oriented product planning, and systematic involvement of industry partners.

The interview findings indicated that school leaders at SMK Negeri PP Cianjur viewed Teaching Factory planning as an effort to integrate vocational learning objectives with agricultural production activities, including the preparation of tools and materials, production schedules, and student work assignments. At SMK Negeri 1 Cugenang, vocational teachers similarly emphasised the importance of organising food-processing activities according to the sequence of production procedures, available resources, and expected learning outcomes.

These findings show that Teaching Factory planning in both schools extended beyond conventional lesson preparation. It required teachers and school leaders to align curriculum targets, available resources, student responsibilities, and production demands within each vocational context. However, the planning process still needs to be strengthened through clearer production targets, written quality standards, market-oriented product planning, and more systematic involvement of industry partners.Overall, the findings suggest that Teaching Factory planning was not limited to lesson preparation, but also involved managing production activities as structured learning experiences. The planning process required teachers to align curriculum targets, available resources, student work assignments, and production demands within each vocational context. However, the findings also indicate that planning in both schools needs to be strengthened through clearer production targets, written quality standards, market-oriented product planning, and more systematic involvement of industry partners.

Organisation of Resources and Industry Partnerships

The organisation of Teaching Factory activities involved school leaders, vocational teachers, students, and industry partners. School principals and vice principals played roles in providing policy direction, supporting facilities, and coordinating programme implementation. Vocational teachers acted as learning facilitators and production supervisors, while students were organised into work groups based on the stages of the production process. Industry partners contributed mainly by providing input related to work standards and the relevance of vocational competencies to industrial needs.

Observations at both schools showed that students were assigned different roles during production activities. Some students prepared tools and materials, others carried out the main production process, and other group members were responsible for packaging, cleaning, and quality inspection. This work division enabled students to experience collaborative work processes similar to those found in industrial settings. One student stated:

"We work in groups; some students prepare the materials, others carry out the production process, and others check the results to ensure that they meet the standards." (S-01)

This finding indicates that the organisation of student roles supported the development of teamwork, responsibility, and work discipline. However, industry involvement was not yet equally strong in all stages of programme implementation. Industry partners were more visible in providing general input and reinforcing industrial standards, while their participation in curriculum planning, product development, competency assessment, and programme evaluation remained limited.

A vocational teacher explained:

"In Teaching Factory activities, students do not only undertake ordinary practice; they follow a work process similar to that in industry, starting from material preparation until they produce products that are ready to be used or marketed." (GP-01)

At SMK Negeri 1 Cugenang, the role of industry partners was reflected in the emphasis on industrial work standards. A representative of an industry partner stated:

"A learning model such as Teaching Factory is important because students become familiar with industrial work standards before entering the labour market." (DUDI-01)

Overall, the organisation of Teaching Factory activities in both schools enabled students to participate in structured work roles and collaborative production processes. The division of responsibilities helped students develop teamwork, discipline, responsibility, and awareness of work procedures. Nevertheless, the findings indicate that the organisational structure should be reinforced through clearer role allocation, more formal coordination mechanisms, and stronger industry participation in programme planning, competency assessment, and product development.

Implementation of Production-Based Learning Activities

The implementation of Teaching Factory at both schools was carried out through production-based learning that involved students directly in work processes resembling industrial conditions. The activities included preparation of equipment and materials, task allocation, production implementation, quality control, packaging, and completion of products. Students did not merely practise isolated technical skills; they participated in an integrated work process that required coordination, adherence to procedures, and responsibility for production outcomes.

At SMK Negeri PP Cianjur, Teaching Factory implementation focused on agricultural activities and agricultural-product processing. Students were involved in cultivation-related activities, processing of agricultural products, and product packaging. The learning process enabled students to understand the production chain from raw materials to finished products. A vocational teacher stated:

"Students do not only learn how to plant or process agricultural products; they also learn how the products are processed until they are ready to be marketed." (GP-01)

At SMK Negeri 1 Cugenang, Teaching Factory implementation was adapted to food-processing competencies. Observations showed that students followed work stages that resembled food-production procedures, including material preparation, processing, hygiene practices, packaging, and product-quality inspection. The implementation emphasised accuracy, cleanliness, work discipline, and compliance with standard operating procedures.

The findings demonstrate that Teaching Factory functioned as an experiential learning environment in both schools. Students learned through direct participation in production activities and were required to perform work tasks in accordance with assigned responsibilities. This condition supports Prosser and Quigley's principle that vocational learning becomes more effective when students learn in environments resembling actual workplaces. The results also indicate that the implementation of Teaching Factory contributed not only to technical skill development but also to the formation of professional work attitudes.

A school principal stated:

"When students are involved in real production activities, they become more motivated because they feel that what they are learning has direct benefits." (KS-01)

Overall, the implementation of Teaching Factory in both schools transformed practical learning into a more authentic work-based learning experience. Although the production fields differed, students in both settings were required to follow production workflows, comply with standard operating procedures, collaborate with peers, and take responsibility for product quality. These findings indicate that Teaching Factory contributed to the development of technical competence and professional work attitudes by bringing workplace practices into the school learning environment.

Evaluation of the Teaching Factory Programme and Student Competence

The evaluation of Teaching Factory activities at both schools was conducted through teacher observation of student participation, work processes, task completion, product quality, and adherence to production procedures. Teachers assessed students during the learning process and evaluated the final products produced by student groups. The evaluation process therefore included both process-oriented and product-oriented dimensions.

Observation results indicated that teachers monitored students' discipline, cooperation, responsibility, accuracy, and ability to follow standard operating procedures. Product quality was also used as an indicator of students' technical competence. In agricultural and agricultural-product processing activities at SMK Negeri PP Cianjur, evaluation focused on the appropriateness of production procedures, the quality of processed products, and packaging outcomes. In food-processing activities at SMK Negeri 1 Cugenang, evaluation emphasised processing accuracy, hygiene, product consistency, packaging, and compliance with quality standards.

Supporting and Inhibiting Factors in Teaching Factory Implementation

Several factors supported the implementation of Teaching Factory in both schools. These included school leadership support, the commitment of vocational teachers, student participation in production activities, the availability of school production units, and collaboration with business and industry partners. The presence of production-based learning activities created opportunities for students to gain work experience that was more relevant to their vocational competencies.

However, the findings also identified several inhibiting factors. First, limited facilities and production equipment affected the capacity of schools to conduct production-based learning optimally. Second, variations in students' readiness and technical abilities influenced the smoothness of production activities. Third, not all vocational teachers had adequate industrial experience, which sometimes caused Teaching Factory activities to remain similar to conventional practical learning. Fourth, industry involvement in programme planning, product development, competency assessment, and evaluation was still limited.

To provide a clearer comparison of Teaching Factory implementation across the two research sites, Table 1 summarises the main similarities and differences identified from interviews, observations, and document analysis. The comparison focuses on vocational focus, production activities, student involvement, teacher roles, industry partnerships, competence development, and implementation challenges. This comparison is important because, although both schools implemented the same Teaching Factory approach, the programme was adapted to different vocational contexts and production characteristics.

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Table 1. Comparative Summary of Teaching Factory Implementation

Aspect	SMK Negeri PP Cianjur	SMK Negeri 1 Cugenang	Comparative Interpretation
Vocational focus	Agriculture and agricultural-product processing	Food processing	Both schools applied Teaching Factory according to their vocational characteristics.
Main production activities	Cultivation, agricultural-product processing, packaging	Food preparation, processing, packaging, and quality inspection	The production processes differed, but both followed a production-based learning approach.
Student involvement	Students participated in preparation, cultivation or processing, packaging, and product completion	Students participated in material preparation, food processing, hygiene procedures, packaging, and quality checking	Both schools involved students throughout the work process, rather than limiting them to isolated practice tasks.
Teacher role	Facilitator, technical supervisor, and coordinator of agricultural production activities	Facilitator, production supervisor, and controller of food-processing procedures	Teachers played central roles in connecting learning objectives with production activities.
Industry partnership	Provided input related to agricultural and processing standards	Reinforced food-processing work standards and workplace expectations	Industry involvement was present but required stronger participation in planning, assessment, and product development.
Competence developed	Agricultural and processing skills, responsibility, teamwork, and product-oriented work attitudes	Food-processing skills, hygiene awareness, accuracy, discipline, and quality-control awareness	Teaching Factory contributed to both technical competence and professional work attitudes.
Main challenges	Production facilities, continuity of production cycles, teacher capacity, and market orientation	Processing equipment, consistency of quality standards, teacher capacity, and industry involvement	Both schools experienced resource and partnership constraints, although the specific production contexts differed.

As shown in Table 1, both SMK Negeri PP Cianjur and SMK Negeri 1 Cugenang implemented Teaching Factory as a production-based learning approach that involved students in authentic work processes. The main difference lies in the vocational context and type of production activity. SMK Negeri PP Cianjur focused on agriculture and agricultural-product processing, whereas SMK Negeri 1 Cugenang concentrated on food-processing activities. Despite these contextual differences, both schools demonstrated similar patterns in student task distribution, teacher supervision, and the development of technical competence and professional work attitudes.

Table 2. Summary of Key Findings by Educational Management Function

Educational Management Function	Key Findings	Implication for Student Competence
Planning	Teaching Factory activities were planned according to vocational programmes, learning objectives, tools, materials, and production schedules.	Students received learning experiences that were more closely connected to vocational tasks.
Organising	Students were divided into work groups with different production responsibilities; teachers coordinated learning and production activities.	Students developed teamwork, responsibility, communication, and work discipline.
Implementing	Students were directly involved in production processes, quality inspection, packaging, and task completion.	Students strengthened technical skills and familiarity with industrial work processes.
Evaluating	Teachers assessed work processes, student participation, compliance with procedures, and product quality.	Student competence could be assessed through authentic performance and production outcomes.
Supporting and inhibiting factors	Leadership support and teacher commitment supported implementation; facilities, teacher industrial experience, and limited industry involvement constrained the programme.	Programme effectiveness depended on management capacity, resources, and sustained industry collaboration.

As presented in Table 2, Teaching Factory implementation in both schools involved interconnected management processes. Planning determined the alignment between learning objectives and production activities, organising structured the roles of teachers and students, implementation enabled students to participate in authentic work processes, and evaluation assessed both work processes and product outcomes. Supporting and inhibiting factors influenced the effectiveness of each management function.

The findings also indicate that the contribution of Teaching Factory to student competence was not produced by production activities alone. Rather, competence development emerged from the integration of structured planning, collaborative work organisation, direct production experience, continuous supervision, and authentic assessment. Therefore, Table 2 provides the basis for the following discussion section, which interprets these findings in relation to vocational education theory, educational innovation, and previous studies on Teaching Factory implementation.

Discussion

The findings demonstrate that Teaching Factory implementation in SMK Negeri PP Cianjur and SMK Negeri 1 Cugenang functioned as a work-based learning strategy that connected vocational learning with production activities. In both schools, students were not positioned merely as recipients of instruction but as active participants in production processes. They were involved in preparing tools and materials, carrying out production tasks, monitoring product quality, packaging products, and completing work assignments. This finding confirms that Teaching Factory can create a learning environment that is more authentic than conventional practical instruction because students experience a work process that resembles industrial activity.

The implementation pattern found in this study is consistent with the vocational education principle proposed by Prosser and Quigley (1950), which states that vocational learning becomes more effective

when the learning environment resembles actual workplace conditions. In both research sites, students were required to follow production procedures, divide tasks, cooperate with peers, and complete work according to expected standards. These activities allowed students to learn not only technical procedures but also the routines and responsibilities associated with industrial work. Therefore, Teaching Factory can be interpreted as an effort to bring workplace culture into the school environment.

The findings also show that Teaching Factory planning was broader than ordinary lesson planning. Teachers were required to integrate curriculum objectives, production schedules, tools and materials, student work groups, and expected production outcomes. This indicates that Teaching Factory planning involved two interconnected dimensions: instructional planning and production management. Such integration is important because vocational learning should not separate competency achievement from the work processes through which competence is developed. Similar findings were reported by Sari et al. (2022), who emphasised that Teaching Factory effectiveness depends on systematic learning management, including planning, implementation, and evaluation.

However, the planning processes in both schools still required improvement, especially in relation to written production targets, detailed quality standards, product-market orientation, and structured industry involvement. Although the schools had designed production-based learning activities, planning was still more strongly driven by school-based learning needs than by industry and market demands. This condition suggests that Teaching Factory implementation may not fully achieve its potential when production planning is not consistently connected to industrial standards and product competitiveness. A more market-oriented approach would allow students to understand that product quality, customer needs, and production efficiency are integral elements of workplace competence.

The organisation of resources in both schools showed that student work groups played an important role in supporting Teaching Factory activities. Students were assigned different responsibilities, such as preparing materials, conducting production, packaging products, and checking quality. This work division contributed to the development of collaborative skills, responsibility, discipline, and communication. The finding supports the view that vocational competence should include both technical and non-technical dimensions, particularly teamwork and work attitudes. Roll and Ifenthaler (2021) similarly argued that learning factory environments can support competence development by combining technical learning with collaborative and problem-based work experiences.

The role of vocational teachers was also central to the success of Teaching Factory implementation. Teachers did not only deliver subject content, but also acted as facilitators, production supervisors, quality controllers, and coordinators of student work. This expanded role requires teachers to possess both pedagogical competence and an understanding of industrial work processes. The findings indicate that teachers' ability to manage production-based learning strongly influenced the extent to which Teaching Factory activities resembled authentic workplace practice. This is in line with Hidayat and Sudira (2017), who found that teacher competence and the availability of appropriate facilities were key determinants of successful Teaching Factory implementation.

The evaluation process in both schools reflected an authentic assessment orientation. Teachers assessed student performance through direct observation of work processes, task completion, compliance with procedures, collaboration, and product quality. This assessment approach is more relevant to vocational education because it captures students' ability to apply competencies in practical situations. Rather than assessing knowledge only through written tests, Teaching Factory enables teachers to evaluate how students perform in a production environment. Tisch, Hertle, and Metternich (2018) also highlighted that learning

factory environments should include performance-oriented evaluation because competence development is closely related to the ability to perform tasks in realistic work contexts(Dewi et al., 2025; Irwanto, 2024; Mourtzis, 2018; Rohaeni et al., 2021).

Nevertheless, the findings suggest that assessment systems should be strengthened through the use of structured competency rubrics and industry-referenced performance standards. At present, teacher observation and product assessment formed the primary basis for evaluation. While these approaches were useful, more systematic assessment instruments would improve the consistency and credibility of competency evaluation. Industry involvement is particularly important in this process because industry partners can help validate whether student performance and product outcomes meet workplace expectations. Baena et al. (2017) argued that learning factories become more relevant when they reflect the standards, technologies, and performance expectations of contemporary industrial environments.

Industry partnerships in both schools supported the implementation of Teaching Factory, particularly by reinforcing the importance of workplace standards and employability expectations. However, the involvement of industry partners was still limited in areas such as joint planning, curriculum development, product innovation, competency assessment, and programme evaluation. This indicates that collaboration between schools and industry had not yet developed into a fully integrated partnership. Stronger industry participation is necessary to ensure that Teaching Factory activities remain relevant to workplace needs and technological changes. Abele et al. (2017) emphasised that learning factory development requires sustained collaboration among educational institutions, industrial actors, and other stakeholders to maintain its relevance and effectiveness.

Overall, the findings indicate that the effectiveness of Teaching Factory does not depend solely on the existence of production activities. Its effectiveness emerges from the integration of planning, organisation, implementation, evaluation, teacher capacity, student participation, facilities, and industry collaboration. This interpretation supports Fullan's (2007) argument that educational innovation succeeds when it is supported by leadership, institutional commitment, collaboration, and continuous improvement. Therefore, Teaching Factory should be understood as a comprehensive vocational education ecosystem rather than a stand-alone practical learning activity. Strengthening management systems, professional development for teachers, industrial partnerships, and industry-based assessment will be essential for ensuring that Teaching Factory programmes can sustainably enhance students' competencies and work readiness.(Jauhar, 2025)

Conclusions

This study demonstrates that Teaching Factory should be understood not merely as a production-based learning activity, but as an integrated vocational learning ecosystem in which educational management functions shape the quality of students' learning experiences. Planning, organising, implementing, and evaluating operate as interconnected processes that align curriculum objectives, production activities, work roles, industrial standards, and competency assessment. Through this integration, Teaching Factory contributes to the development of both technical competence and professional work attitudes.

Conceptually, the findings suggest that student competence is not produced by participation in production activities alone. Rather, competence develops when authentic work experiences are supported by systematic management, capable teachers, adequate facilities, structured assessment, and meaningful industry collaboration. This perspective extends previous understandings of Teaching Factory by positioning educational management as a key mechanism linking production-based learning with vocational competence development.

Therefore, strengthening Teaching Factory requires schools to move beyond activity-based implementation toward a more integrated management approach. Greater attention should be given to teacher industrial capacity, industry-referenced assessment, production planning, and sustained partnerships with business and industry. Future research may further examine how these management mechanisms influence graduate employability, workplace adaptation, and competency development across different vocational contexts.

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