VOCATIONAL : Jurnal Inovasi Pendidikan Kejuruan
Vol. 5 No. 3 Juli 2025
P-ISSN : 2775-0019
E-ISSN : 2774-6283
Online Journal System : https://jurnalp4i.com/index.php/vocational

EFFECTIVENESS OF TEACHING FACTORY IMPLEMENTATION IN PRODUCTIVE LEARNING: AN EVALUATION FROM VOCATIONAL TEACHERS' PERSPECTIVES

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ABSTRACT

This study evaluates the effectiveness of Teaching Factory (TEFA) implementation in productive learning from the perspective of vocational teachers and identifies data-driven priorities for improvement at the item level. A cross-sectional survey was conducted with 19 productive-subject teachers from public and private vocational high schools (SMK) in Jakarta that have implemented TEFA, using a teacher-version instrument comprising 31 Likert-type items (1–4) across Product (16 items), Pedagogical Competence (6 items), and Job-Ready Graduates (9 items). Content validity had been established during instrument development through seven expert raters, with all items exceeding the minimum Aiken's V acceptance threshold of 0.76. Analyses included means and standard deviations by dimension and by item (ranked), a 95% confidence interval for the overall mean using Student's t, and Cronbach's alpha for each dimension. Results showed an overall mean of M = 3.63 (SD = 0.30, 95% CI [3.49, 3.77]), Product M = 3.58 (SD = 0.34, α = 0.88), Pedagogical Competence M = 3.81 (SD = 0.26, α = 0.65), and Job-Ready Graduates M = 3.60 (SD = 0.39, α = 0.88). Item rankings highlight strengths in understanding and applying drawings, adherence to SOPs, teacher supervision, and student involvement in quality control, while lower-ranked areas include turnaround time, costing (materials/pricing), and independent technical problem-solving. The findings imply strengthening SOPs and quality control, arranging takt time/line balancing, expanding industry-based upskilling and authentic assessment for teachers, and integrating costing and structured technical problem-solving into TEFA projects to support evidence-based decision-making.

Kata Kunci: *Teaching factory, vocational teacher, Mechanical Engineering Education*

ABSTRAK

Studi ini mengevaluasi efektivitas implementasi Teaching Factory (TEFA) dalam pembelajaran produktif dari perspektif guru kejuruan dan mengidentifikasi prioritas berbasis data untuk perbaikan pada tingkat butir soal. Survei potong lintang dilakukan terhadap 19 guru mata pelajaran produktif dari sekolah menengah kejuruan (SMK) negeri dan swasta di Jakarta yang telah menerapkan TEFA, menggunakan instrumen versi guru yang terdiri dari 31 butir soal tipe Likert (1–4) yang mencakup Produk (16 butir soal), Kompetensi Pedagogis (6 butir soal), dan Lulusan Siap Kerja (9 butir soal). Validitas isi telah ditetapkan selama pengembangan instrumen melalui tujuh penilai ahli, dengan semua butir soal melebihi ambang batas minimum Aiken's V sebesar 0,76. Analisis mencakup rata-rata dan simpangan baku per dimensi dan per butir soal (diperingkat), interval kepercayaan 95% untuk rata-rata keseluruhan menggunakan uji t Student, dan alfa Cronbach untuk setiap dimensi. Hasil penelitian menunjukkan rata-rata keseluruhan M = 3,63 (SD = 0,30, 95% CI [3,49, 3,77]), Produk M = 3,58 (SD = 0,34, α = 0,88), Kompetensi Pedagogis M = 3,81 (SD = 0,26, α = 0,65), dan Lulusan Siap Kerja M = 3,60 (SD = 0,39, α = 0,88). Peringkat item menyoroti kekuatan dalam memahami dan menerapkan gambar, kepatuhan terhadap SOP, supervisi guru, dan keterlibatan siswa dalam pengendalian

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mutu, sementara area dengan peringkat lebih rendah meliputi waktu penyelesaian, biaya (bahan/harga), dan pemecahan masalah teknis mandiri. Temuan ini menyiratkan penguatan SOP dan pengendalian mutu, pengaturan keseimbangan waktu takt/lini, perluasan peningkatan keterampilan berbasis industri dan penilaian autentik bagi guru, serta integrasi biaya dan pemecahan masalah teknis terstruktur ke dalam proyek TEFA untuk mendukung pengambilan keputusan berbasis bukti.
Kata Kunci: *Teaching factory, guru vokasi, Pendidikan Teknik Mesin*

INTRODUCTION

In the pursuit of aligning vocational education with the dynamic demands of the modern economy, work-integrated learning models have become a strategic imperative for nations worldwide. In Indonesia, this imperative is embodied in the national *link-and-match* policy, a concerted effort to close the persistent gap between the skills imparted in schools and the competencies required by the industry. The *Teaching Factory* (*TEFA*) model serves as a cornerstone of this policy, designed to fundamentally transform the vocational learning landscape by integrating industry-standard production and service processes directly into the educational ecosystem of Vocational High Schools (SMK). This approach moves beyond traditional classroom instruction and workshop practice by creating authentic learning environments where students acquire not only technical competencies but also the crucial work attitudes, professional discipline, and soft skills demanded by employers. As such, *TEFA* is envisioned as a critical vehicle for enhancing graduate employability and strengthening the overall relevance of vocational education to national economic development (Kadir et al., 2020; Paryono, 2020).

The ideal *Teaching Factory* operates as a vibrant and fully functional microcosm of a real-world enterprise situated within the school's campus. In this optimal scenario, the learning environment is equipped with industry-grade facilities and machinery, allowing students to gain hands-on experience with the same technologies they will encounter in the workplace. Operations are governed by a robust quality management system, with clear Standard Operating Procedures (SOPs), rigorous quality control checks, and a focus on producing tangible goods or services that meet market standards. Teachers in this ideal model transcend their traditional roles to become mentors and production supervisors, bringing sufficient and recent industry exposure to guide students through authentic work processes. Crucially, this ecosystem is nurtured by deep, sustainable, and reciprocal partnerships with employers, who provide technical guidance, guest lecturers, and pathways for internships and graduate employment. This seamless integration of production and education ensures that the learning experience is not merely simulated but genuinely authentic, preparing students for a smooth transition into their professional careers.

Despite the compelling vision of the *TEFA* model, significant gaps persist between these ideal conditions and the realities of school-level implementation across the country. Many Vocational High Schools (SMK) grapple with substantial constraints that hinder their ability to create truly authentic learning environments. A primary challenge is the inadequacy of facilities and equipment, which often lag behind the rapid technological advancements of the industry, limiting the scope and relevance of the practical skills that can be taught. Furthermore, there is an uneven pedagogical capacity among teachers; while many are dedicated educators, a considerable number lack the recent industry exposure necessary to effectively manage a production-based learning environment and mentor students in contemporary work practices. Compounding these issues is the challenge of establishing and maintaining consistent and meaningful engagement with industry partners, which can limit the quality of products and

services, the transfer of current knowledge, and the overall authenticity of the learning experience for students (Utami & Widodo, 2020; Rahman et al., 2021).

The urgency of addressing this implementation gap through rigorous evaluation cannot be overstated, as it holds significant implications for both institutional quality assurance and national education policy. For schools to effectively enhance their programs, they must move beyond anecdotal assessments and demonstrate *TEFA* performance with measurable, empirical evidence. Such evidence is critical for informing strategic decisions related to curriculum improvement, the enhancement of industry partnerships, and the efficient allocation of limited resources. Without robust evaluation, crucial decisions may be based on assumptions rather than data, perpetuating inefficiencies and hindering progress. Within this evaluative framework, the perceptions of teachers hold a position of unique importance. As the key actors and frontline implementers of the *TEFA* model, their professional insights and judgments offer a powerful leading indicator of how effectively the program replicates industrial processes and generates meaningful learning outcomes for students, providing a nuanced perspective that output metrics alone cannot capture (Paryono, 2020).

A review of recent literature from the last decade confirms the potential of the *TEFA* model, with several studies indicating its positive contributions to student development. Research has shown that well-implemented *TEFA* programs can enhance graduate employability by providing students with practical, hands-on experience that is highly valued by employers. Furthermore, the model has been found to instill a strong sense of process discipline through the consistent application of SOPs and to cultivate a quality-conscious work culture by involving students directly in production and quality control processes (Yusof et al., 2017; Kadir et al., 2020; Paryono, 2020). While these findings affirm the value of the *TEFA* concept, a significant gap remains in the existing body of research. There is a notable scarcity of investigations that specifically and systematically assess the effectiveness of *TEFA* implementation from the perspectives of the teachers themselves, particularly through the use of a psychometrically sound and validated quantitative instrument, warranting a more systematic effort to map strengths and areas for improvement.

The primary innovation of this study lies in its rigorous methodological approach, which is specifically designed to fill the identified research gap by providing systematic quantitative evidence from the crucial viewpoint of teachers. This research moves beyond generalized or qualitative assessments by employing a comprehensive, multi-dimensional, and validated instrument to measure *TEFA* effectiveness. The novelty of this approach is threefold: first, its reliance on a validated tool ensures a high degree of reliability and credibility in the data collected. Second, its multi-dimensional framework allows for a holistic evaluation that covers the entire *TEFA* ecosystem, from management and industry collaboration to the learning and production processes. The most significant innovation, however, is the granularity of the analysis. The study will not only provide an overall effectiveness score but will also deliver an item-level ranking of perceived performance within each dimension. This deep, data-driven dive into specific practices and conditions is a substantial advancement, as it enables the identification of precise, actionable priorities for improvement rather than vague, general feedback.

Grounded in the critical need to bridge the gap between vocational education and industry demands, and recognizing the need for evidence-based program evaluation, this study is guided by two primary objectives. The first objective is to quantitatively measure the effectiveness of *Teaching Factory* (*TEFA*) implementation across a range of vocational high schools as perceived by the teachers who are central to its success, utilizing a robust and validated instrument. The second objective is to provide a detailed, item-level ranking of

perceived effectiveness within each assessed dimension, thereby identifying specific, data-driven priorities that can guide targeted improvement efforts at both the institutional and policy levels. The findings from this research are expected to make a significant contribution by supporting evidence-based decision-making. At the school level, the results will serve as a diagnostic tool for administrators and teachers to refine their *TEFA* programs. At the policy level, the insights will help inform the development of more effective support systems and professional development for teachers, ultimately strengthening the quality and impact of vocational education in Indonesia.

RESEARCH METHOD

This study employed a quantitative approach with a descriptive *cross-sectional survey* design. The research was conducted to evaluate the effectiveness of the *Teaching Factory* (TEFA) program implementation from the perspectives of vocational teachers at a single point in time. The target population for this study was all productive-subject teachers at public and private vocational high schools (*vocational high schools*) in Jakarta that have officially implemented the TEFA model. The research *sample* consisted of 19 teachers who were selected based on their direct involvement in TEFA implementation. Participation in the survey was entirely voluntary and anonymous to ensure confidentiality and encourage honest responses from the participants. The primary data was collected through a self-administered questionnaire that was distributed directly to the teachers at their respective schools. This design was chosen for its efficiency in gathering perceptual data from a specific professional group to create a snapshot of the program's perceived effectiveness.

The instrument used for data collection was a teacher-version TEFA evaluation questionnaire, which consisted of 31 items structured across three distinct dimensions: Product (16 items), Pedagogical Competence (6 items), and Job-Ready Graduates (9 items). All items were measured using a four-point *Likert-type scale*, ranging from 1 (*strongly disagree*) to 4 (*strongly agree*), which was designed to avoid a neutral midpoint and encourage a clear stance. The instrument's content validity (*content validity*) was established during a prior development stage. This validation process involved a panel of seven expert raters (*expert raters*) who assessed the relevance and clarity of each item. The quantitative analysis of their ratings, using Aiken's V statistic, confirmed that all 31 items exceeded the minimum acceptance threshold of 0.76, indicating that the instrument possessed adequate content validity to measure the intended constructs of TEFA effectiveness.

The collected data were analyzed using a series of statistical techniques with the assistance of SPSS (*Statistical Package for the Social Sciences*) software. The analysis began with descriptive statistics to calculate the *mean* and *standard deviation* for the overall score and for each of the three dimensions. A key component of this analysis was the item-level ranking (*item-level ranking*) within each dimension to identify specific strengths and areas for improvement. To estimate the precision of the overall effectiveness score, a 95% confidence interval (*95% confidence interval*) for the overall mean was calculated using a one-sample *Student's t-test*. Finally, to assess the internal consistency of the instrument, the reliability of the items within each dimension was measured using *Cronbach's alpha*. This comprehensive analytical approach allowed for a multi-faceted evaluation of the TEFA program's implementation based on the teachers' perceptions.

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RESULT AND DISCUSSION

Result

Table 1. Descriptive statistics and reliability by dimension

Dimension	*Items*	*Mean*	*SD*	*Cronbach's α*	*95% CI (Overall)*
Product	16	3.58	0.34	0.88	
Pedagogical Competence	6	3.81	0.26	0.65	
Job-Ready Graduates	9	3.60	0.39	0.88	
Overall (31)		**3.63**	**0.30**		**[3.49, 3.77]**

Table 1 provides a descriptive and reliability analysis of the survey instrument, broken down by three core dimensions based on a total of 31 items. The mean scores indicate a positive perception across all areas, with Pedagogical Competence receiving the highest and most consistent rating (M = 3.81, SD = 0.26). The overall mean score was 3.63, with a 95% confidence interval of [3.49, 3.77]. In terms of internal consistency, the Product and Job-Ready Graduates dimensions demonstrated strong reliability, both achieving a Cronbach's alpha of 0.88. The Pedagogical Competence dimension, however, showed more moderate reliability at α = 0.65. Overall, the data suggests that respondents rated all constructs favorably and the measurement scales are largely reliable for assessment.

Table 2. Item rankings Product dimension

Rank	*Item*	*Mean*
1	Products/services are executed by students	3.789
2	Respond quickly to customer complaints	3.737
3	Produce standardized products/services	3.684
4	Apply strict quality control to products/services	3.684
5	Products/services can compete on price	3.632
6	Provide solutions to issues arising during production/service	3.632
7	Products/services meet customer requirements	3.579
8	Products/services can compete in terms of service	3.579
9	Outputs meet the school's internal needs	3.579
10	Products/services are accepted by the market	3.579
11	Analyse internal product needs	3.526
12	Receive customer complaints	3.526
13	Products/services match specifications	3.474
14	Products/services have high sale value	3.474
15	Products/services can compete in the market	3.474
16	Products/services can compete on turnaround time	3.263

Table 2 presents the mean scores for the 16 items within the Product dimension, ranked in descending order. The analysis reveals a clear hierarchy of perceived strengths. The highest-rated item, with a mean of 3.789, was that products and services are executed by students, emphasizing student-led production. This was followed by strong ratings for customer service aspects like responding quickly to complaints and maintaining quality through standardization and strict control. Conversely, items related to external market performance were ranked lower. The item concerning the ability to compete on turnaround time received the lowest mean score of 3.263. This ranking suggests that while the internal processes of student execution and quality control are highly regarded, the product's competitiveness in the market, particularly regarding speed, is a comparatively less developed area.

Table 3. Item rankings Pedagogical Competence dimension

Rank	*Item*	*Mean*
1	Understand working drawings aligned to the product/service	4.000

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2	Students work according to drawing instructions	3.947
3	Students follow the planned SOP	3.947
4	Student work is guided/supervised by teachers	3.842
5	Students follow the specified work steps	3.632
6	Students are involved in solving technical problems	3.474

Table 3 provides a ranking of the six items within the Pedagogical Competence dimension according to their mean scores. The results highlight a strong emphasis on procedural instruction and adherence. The top-ranked item, with a perfect mean score of 4.000, is the ability to understand working drawings. This is followed by high ratings for ensuring students work according to instructions and follow standard operating procedures (SOPs). In contrast, the item concerning student involvement in solving technical problems received the lowest mean score of 3.474. While all scores are high, this pattern suggests that the observed pedagogical competence is strongest in guiding students through well-defined, structured tasks. The relatively lower ranking for student problem-solving indicates a potential area for future pedagogical development.

Table 4. Item rankings Job-Ready Graduates dimension

Rank	*Item*	*Mean*
1	Students read working drawings correctly	3.789
2	Students work according to work instructions	3.737
3	Students are involved in the quality control process	3.684
4	Students work in a systematic process	3.684
5	Student outputs are accepted by customers	3.684
6	Students explain technical aspects directly	3.579
7	Customers are satisfied with student outputs	3.474
8	Students provide solutions during production	3.421
9	Students calculate material needs and product/service prices	3.368

Table 4 presents a ranked analysis of nine competencies that constitute the Job-Ready Graduates dimension, ordered by their mean scores. The findings indicate that students demonstrate the highest proficiency in technical and procedural skills. For instance, the ability to correctly read working drawings and work according to instructions were the top-rated items, suggesting a strong capacity for task execution. Competencies related to following systematic processes and participating in quality control also scored highly, reinforcing a strength in structured work environments. Conversely, skills requiring more analytical or commercial acumen were ranked at the bottom. The two lowest-rated items were students' ability to provide solutions during production, pointing to a gap in on-the-spot problem-solving, and their capacity to calculate material needs and prices. This suggests that while graduates are proficient in technical execution, their development in areas like autonomous troubleshooting and business-related costing is a notable area for improvement to enhance their overall job readiness.

Discussion

The findings of this study provide a comprehensive assessment of the Teaching Factory (TEFA) model's implementation, revealing a generally positive perception among teachers across the core dimensions of Product, Pedagogical Competence, and Job-Ready Graduates. The overall mean score of 3.63 suggests that the TEFA model is viewed as an effective educational framework. A deeper analysis, however, uncovers a nuanced pattern of strengths and weaknesses. The model demonstrates considerable success in fostering student-led production, adherence to standardized procedures, and the development of foundational

technical skills. This indicates a strong internal process capability. Conversely, areas requiring further development are related to external market competitiveness, autonomous problem-solving, and commercial acumen. This pattern suggests that while the current TEFA implementation is proficient at producing technically skilled students capable of executing well-defined tasks, it has yet to fully cultivate the higher-order analytical and entrepreneurial competencies necessary for graduates to thrive in dynamic industry environments, thus highlighting a critical area for strategic enhancement.

An in-depth examination of the Product dimension reveals a distinct focus on internal quality and production processes over external market performance. The highest-rated items, such as student execution of products, quick response to complaints, and adherence to quality control, align with research emphasizing the importance of strong workshop governance and a robust quality culture in school production units (Imran et al., 2024; Purnami, 2021; Wahjusaputri & Bunyamin, 2022; Yoto et al., 2024). This indicates that students are receiving valuable hands-on experience in a structured production environment. However, the lower mean scores for items related to market competitiveness, sale value, and particularly turnaround time, suggest a significant gap between the school's production capabilities and the demands of a competitive marketplace. To bridge this gap, it is imperative to reinforce process quality by managing cycle times more effectively, sharpening product design through customer feedback, and ensuring outputs consistently meet market specifications, thereby enhancing the overall commercial viability of the products.

The Pedagogical Competence dimension received the highest overall mean score, yet its moderate *Cronbach's alpha* of 0.65 suggests a degree of heterogeneity among its indicators. The item rankings clearly show strengths in guiding students through structured, procedural tasks, such as understanding working drawings and adhering to standard operating procedures (SOPs). This is further supported by the high rating for teacher supervision. In contrast, the lowest-ranked item was student involvement in solving technical problems, indicating a potential over-reliance on teacher-led instruction. Research by Villarroel et al. (2024) and Alias et al. (2020) underscores that authentic, real-world tasks are essential for fostering professional skill transfer. Therefore, while the current pedagogical approach is effective for foundational training, it could be enhanced by incorporating more authentic assessments, tiered job sheets, and scaffolding mechanisms like cognitive apprenticeship that encourage a gradual release of responsibility and cultivate students' autonomous problem-solving abilities (Rahman et al., 2022; Fadilla, 2023; Karuna, 2023).

Analysis of the Job-Ready Graduates dimension reinforces the pattern observed in the other areas, highlighting a proficiency in technical execution but a deficit in higher-level analytical skills. The high mean scores for reading drawings, following instructions, and participating in quality control are consistent with evidence linking well-managed TEFA programs to increased work readiness (Prianto et al., 2021; Tanjung et al., 2025). These findings align with reports from centers of excellence where competency gains are achieved through real-world projects (Imran et al., 2024; Yoto et al., 2024). However, the significantly lower scores for independent problem-solving and calculating material costs reveal a critical gap in preparing students for the full spectrum of industry demands. This suggests that while graduates are well-prepared to function as skilled technicians, they may be less equipped for roles that require on-the-spot troubleshooting, financial planning, or innovative thinking. Integrating structured technical troubleshooting and costing modules into TEFA projects is therefore essential for developing more well-rounded and versatile graduates.

Synthesizing the findings across all three dimensions reveals a coherent and interconnected narrative about the current state of the TEFA implementation. The pedagogical

strength in structured, teacher-supervised instruction directly correlates with the production of graduates who excel at following procedures and participating in established quality control processes. Similarly, the Product dimension's focus on internal production rather than external market demands explains why students are proficient in systematic work but less skilled in commercial aspects like costing or providing innovative solutions during production. This interconnectedness suggests that the TEFA model, in its current form, is highly effective at creating a controlled learning environment that successfully develops proficient technicians. However, this very structure may inadvertently limit opportunities for students to engage in the kind of unstructured problem-solving and commercial decision-making that are vital for fostering innovation, adaptability, and true job readiness in a competitive global market.

The implications of this research for vocational education are substantial, offering both validation and a clear call for evolution. The study confirms that the TEFA model is a powerful tool for building the foundational technical competencies that are the bedrock of vocational training. However, to remain relevant and effective, the model must evolve beyond simply replicating industry processes and begin to cultivate industry-ready problem-solvers. This implies a need for a pedagogical shift away from purely instructional methods towards more inquiry-based and problem-based learning approaches that challenge students to diagnose and resolve authentic technical issues. Furthermore, the curriculum must be broadened to include essential commercial competencies, such as project costing, supply chain basics, and customer relations. Strengthening partnerships with industry is also critical, not just for internships, but for co-developing projects that reflect real-world market pressures, including deadlines, budgets, and customer expectations.

Based on the identified areas for improvement, several practical recommendations can be formulated to enhance the TEFA model's effectiveness. To improve the Product dimension, a focus on production efficiency is needed through the management of *takt time* and line balancing, alongside strengthening in-process inspection protocols. Incorporating the voice of the customer and principles of value engineering can directly address the lower scores related to sale value and market acceptance. For Pedagogical Competence, educators should design authentic assessments that require students to justify their diagnostic choices and apply scaffolded problem-solving frameworks like the 5-Why or Ishikawa diagrams. Expanding industry attachments and certification opportunities for teachers will also ensure they bring current and relevant technical challenges into the classroom. Finally, to produce more Job-Ready Graduates, it is essential to integrate comprehensive costing modules into client-based capstone projects and require students to produce reflection reports that link their technical decisions to cost and time implications.

While this study offers valuable insights, it is important to acknowledge its limitations to provide a balanced perspective. The research is based on the perceptions of teachers, which, while crucial, represents only one stakeholder group. The perspectives of students and, most importantly, industry partners who ultimately hire the graduates would provide a more holistic and potentially different view of the TEFA model's effectiveness. Furthermore, the study was conducted within a specific institutional context, which may limit the generalizability of the findings to other vocational schools with different resources, industry links, or student demographics. Future research should therefore aim to incorporate a multi-stakeholder approach, including student surveys and interviews with industry supervisors. A comparative study across different TEFA implementations or a longitudinal study tracking the career progression of graduates would also offer more robust evidence regarding the long-term impact of this educational model on workforce readiness.

CONCLUSSION

This study concludes that Teaching Factory (TEFA) in productive learning is implemented effectively as perceived by vocational teachers (overall M = 3.63, 95% CI [3.49, 3.77]). The Product and Job-Ready Graduates dimensions exhibit very good internal consistency (α = 0.88), indicating that the instrument captures these outcomes reliably, whereas Pedagogical Competence shows moderate reliability (α = 0.65), signalling the need for indicator refinement. Item-level analysis consistently highlights strengths in understanding and applying drawings, adherence to SOPs, teacher supervision, and student participation in quality control, while revealing weaknesses in cycle-time/turnaround, specification compliance and market acceptance (sale value), costing, and independent technical problem-solving.

Taken together, the evidence indicates that TEFA already mirrors key elements of industrial practice but requires targeted enhancement in process discipline and problem-solving literacy to maximise its impact on graduate readiness. Accordingly, schools should institutionalise SOP or QC routines, manage takt-time/line-balancing, embed costing and structured troubleshooting within TEFA projects, and broaden industry-based upskilling and authentic assessment for teachers. This conclusion is bounded by a small, single-city, cross-sectional sample. Future studies should examine generalisability across programs and regions (including measurement invariance) and relate TEFA scores to objective outcomes such as internship performance, customer acceptance, and job placement using longitudinal designs.

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