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Evaluating teaching factory implementation in vocational centers of excellence using the CIPP model: a mixed-methods study

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ABSTRACT

This study evaluated the Teaching Factory program in three Vocational Centers of Excellence in Binjai City, Indonesia, using the Context, Input, Process, and Product (CIPP) model. A sequential explanatory mixed-methods design combined questionnaire data from the total population of 9 teachers and 128 students, selected through purposive sampling, with interviews, observation, and documentation. Achievement scores were positive for both groups on Context (teachers 82.4%, students 84.6%), Process (83.2%, 77.4%), and Product (81.1%, 79.9%). The clearest divergence emerged on Input: teachers rated resource readiness positively (83.3%), while students rated it the weakest component (69.0%), indicating a gap between policy-level resourcing and field-level experience, particularly in equipment standardization and facility capacity. Qualitative findings converged with this pattern, confirming all three schools remained at an early, competency-fulfilment stage rather than a market-oriented production stage. The program is feasible to continue, provided industrial partnership, input governance, and facility investment are strengthened.

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Introduction

Vocational high schools are expected to shorten the transition from school to work by producing graduates with technical competence and adaptive employability, yet in Indonesia this remains difficult to achieve. National data place vocational graduates among the education groups with the highest open unemployment (8.63%); the same pattern holds in North Sumatra (5.60%) and, more locally, in Binjai City (8.14%, the highest among education groups and still rising from the previous year). These figures indicate that vocational education does not automatically create employability when learning remains weakly connected to industrial standards, and international evidence warns that vocational pathways require ongoing links with labour demand to avoid skill obsolescence (Hanushek et al., 2017; Bolli et al., 2018; Estriyanto, 2021; Prayogo et al., 2026; Azahar et al., 2026; Sarwa et al., 2026).

Teaching Factory (TEFA) has emerged as a strategic model for narrowing this gap by connecting academic learning with real production work (Alptekin et al., 2001; Abele et al., 2015; Chryssolouris et al., 2016; Rentzos et al., 2014). Indonesian studies, however, report recurring implementation gaps in human resources, infrastructure, and industry collaboration (Saputro et al., 2023; Kautsar et al., 2022), underscoring the need for locally grounded evaluation rather than generic assumptions of success.

In Binjai City, three funded Vocational Centers of Excellence SMK Swasta Putra Anda Binjai, SMK Swasta Setia Budi Binjai, and SMK Swasta Teknik Paba Binjai implemented TEFA in 2023, all positioned at Category 1, meaning TEFA mainly fulfils student competence rather than serving wider community or industrial production. Preliminary observations identified problems spanning equipment standards, teacher readiness, industry involvement, financial governance, and product competitiveness. Consistent with prior CIPP-based TEFA studies, implementation quality must be judged through Context, Input, Process, and Product indicators rather than a single output score (Wijanarka et al., 2023; Imran et al., 2024; Hakan & Fer, 2011). This article therefore evaluates TEFA implementation in these three schools through a CIPP-based mixed-methods study integrating questionnaire data with interviews, observation, and documentation.

The study formulates four operational objectives, each mapped to one CIPP component: (1) the relevance of TEFA to school vision, policy, and industry demand (Context); (2) the readiness of teachers, facilities, funding, and production resources (Input); (3) the implementation of production-based learning, coordination, and quality control (Process); and (4) outcomes for students' skills, work attitudes, and school–industry collaboration (Product). This study contributes a locally grounded, multi-stakeholder account of implementation at Category 1 schools, a maturity level that has received comparatively little empirical attention in the CIPP-based Teaching Factory literature (Wijanarka et al., 2023; Yoto et al., 2024).

Method

Research Design

This study employed an evaluative mixed-methods design using a sequential explanatory approach. This design was selected because the study aimed to assess the implementation of the Teaching Factory (TEFA) program through numerical evidence and then clarify the quantitative findings through qualitative data. The first phase used questionnaires to obtain quantitative information from teachers and students regarding the implementation of TEFA in Vocational Centers of Excellence in Binjai City. The second phase used interviews, observation, and documentation to explore the meaning behind the quantitative patterns, especially from school leaders, productive teachers, program heads, and industry partners. This sequence follows the logic of explanatory mixed-methods research, where qualitative findings are used to explain, strengthen, or refine the initial quantitative results (Creswell & Plano Clark, 2018). The evaluation structure was guided by the Context, Input, Process, and Product (CIPP) model, which is suitable for examining educational programs from planning needs to implementation outcomes (Stufflebeam & Zhang, 2017). In this study, the context component examined program relevance, school vision, policy support, and industry needs. The input component assessed teachers, facilities, funding, curriculum readiness, and production resources. The process component examined production-based learning, school–industry coordination, and quality control. The product component assessed students' skills, work attitudes, product outcomes, marketing, and school image. The integration of quantitative and qualitative findings was conducted at the interpretation stage to produce a complete evaluation of TEFA implementation across the four CIPP components.

This sequential explanatory design was chosen over a concurrent or a transformative design because the guiding evaluation questions in this study are descriptive and explanatory rather than confirmatory or advocacy-driven. A concurrent design was considered less suitable because collecting and merging the two data strands at the same time would blur the attribution of specific CIPP indicators to either strand, making it harder to show which quantitative pattern a given qualitative finding was explaining. A transformative design was not selected because the purpose of this evaluation was to produce a neutral, evidence-based feasibility assessment for program management rather than to advance a particular stakeholder agenda. The two-phase sequence also matches the practical evaluation flow required by the participating schools, in which a quantitative screening across all Context, Input, Process, and Product indicators was needed first to identify which components required deeper qualitative explanation.

Research Setting and Study Context

The study was conducted in Binjai City, North Sumatra, Indonesia, with a specific focus on Vocational High School Centers of Excellence that had implemented the Teaching Factory program and received program funding in 2023. Three schools were selected as research sites: SMK Swasta Putra Anda Binjai, SMK Swasta Setia Budi Binjai, and SMK Swasta Teknik Paba Binjai. These schools were considered relevant because they represented funded vocational institutions that had formally adopted Teaching Factory as part of the Vocational Center of Excellence agenda. The research was carried out in November 2025, covering preparation, data collection, and data analysis activities. The study context was shaped by the position of the three schools in category 1 Teaching Factory implementation, which emphasizes the fulfillment of students' hard skills and soft skills rather than wider market-based production or stable industrial partnership. This category reflects schools that use production activities mainly as learning media, with products primarily directed to internal school needs and limited production capacity. The field context also showed several implementation issues that required systematic evaluation, including equipment that did not fully meet industrial standards, limited teacher mastery of updated production technology, weak active involvement of industry partners, unclear financial governance, incomplete curriculum integration, limited product competitiveness, unequal student participation, schedule conflicts with regular learning, limited policy support, and the absence of industry-recognized certification for student products or skills. These site characteristics provided a suitable empirical setting for evaluating Teaching Factory implementation through the Context, Input, Process, and Product framework.

Table 1. Profile of Vocational Centers of Excellence Implementing Teaching Factory in Binjai City

Vocational Center of Excellence	School Status	Location	Teaching Factory Program Status	Funding Year	Implementation Category	Main Orientation
SMK Swasta Putra Anda Binjai	Private vocational high school	Binjai City, North Sumatra, Indonesia	Implemented Teaching Factory under the Vocational Center of Excellence program	2023	Category 1	Fulfilment of students' hard skills and soft skills
SMK Swasta Setia Budi Binjai	Private vocational high school	Binjai City, North Sumatra, Indonesia	Implemented Teaching Factory under the Vocational Center of Excellence program	2023	Category 1	Fulfilment of students' hard skills and soft skills
SMK Swasta Teknik Paba Binjai	Private vocational high school	Binjai City, North Sumatra, Indonesia	Implemented Teaching Factory under the Vocational Center of Excellence program	2023	Category 1	Fulfilment of students' hard skills and soft skills

Table 2. Teaching Factory Implementation Categories and Achievement Indicators Used to Classify Program Maturity in Vocational Centers of Excellence

Achievement Indicator	Category 1: Competency Fulfilment	Category 2: Community Needs	Category 3: Industry Partnership
Focus on students' hard skills and soft skills	✓	✓	✓
Product or service quality follows workplace standards	✓	✓	✓
Production is based on school needs	✓	✓	✓
Products are used internally by the school	✓	✓	✓
Production capacity remains limited	✓	✓	✓
Production is based on customer orders		✓	✓
Products are used by the wider community		✓	✓
Administration includes financial transaction records		✓	✓
Production is conducted jointly with industry partners			✓
Production reaches a mass-production scale			✓

Note: Category 1 refers to Teaching Factory implementation focused on students' competency fulfilment. Category 2 extends the program toward community-based production. Category 3 represents a more advanced implementation level through stable partnership with the world of work and wider production capacity.

Participants and Sampling Technique

The participants in this study included internal and external stakeholders who were directly involved in the Teaching Factory program in three Vocational Centers of Excellence in Binjai City. The internal participants consisted of school principals, vice principals for curriculum, vice principals for facilities and infrastructure, vice principals for public relations and industry partnership, heads of expertise programs, productive subject teachers, and students participating in Teaching Factory activities. External participants consisted of industry partners who had formal cooperation with the schools in training, production, assessment, or program support. The sampling technique was adjusted to the mixed-methods design. Quantitative respondents were selected using purposive sampling: because eligibility depended on direct, active involvement in Teaching Factory implementation rather than on random selection from a larger population, the entire population of teachers and students meeting this criterion was included as respondents. This yielded a total quantitative sample of 9 productive teachers and 128 students across the three schools. Qualitative informants were selected using

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purposive sampling based on their role, experience, and direct involvement in Teaching Factory planning and implementation. The main qualitative informants included principals, vice principals, heads of expertise programs, and industry partners. Students were included when they were actively involved in the current Teaching Factory program and had completed at least one production cycle or project. Industry partners were included when they had official collaboration with the school and contributed to training, production activities, or evaluation of student outputs.

CIPP Evaluation Framework

The evaluation framework in this study was organized using the Context, Input, Process, and Product (CIPP) model. This model was selected because it provides a structured and comprehensive approach for evaluating educational programs from program needs to implementation outcomes. Recent studies show that the CIPP model remains relevant for educational evaluation because it can examine program goals, resource readiness, implementation quality, and achieved results in an integrated manner (Lee et al., 2019; Ratnaya et al., 2022). In this study, the context component assessed the relevance of the Teaching Factory program to school vision, government policy, community needs, industrial demand, and partner involvement. The input component examined program planning, teacher readiness, teacher training, facilities, infrastructure, funding support, production resources, and raw material availability. The process component focused on production-based learning, coordination among school units, collaboration with industry, supervision of student activities, and product quality control. The product component assessed students' technical skills, work attitudes, product outcomes, marketing practices, and the contribution of the program to the school's public image. A recent Teaching Factory evaluation study also used the CIPP model to assess feasibility through context, input, process, and product dimensions in vocational high schools (Yoto et al., 2024). The four components were used to guide questionnaire construction, interview mapping, and documentation review across the selected schools.

Data Collection Instruments and Procedures

The data collection instruments consisted of questionnaires, semistructured interview guides, observation sheets, and documentation sheets. The questionnaires were developed for productive teachers and students to measure the implementation of Teaching Factory across the Context, Input, Process, and Product components. Each item was arranged from the evaluation indicators and used a Likert-type response scale to capture perceptions of program relevance, resource readiness, learning implementation, and program outputs. The interview guides were prepared for principals, vice principals for curriculum, vice principals for facilities and infrastructure, vice principals for public relations and industry partnership, heads of expertise programs, and industry partners. The questions explored policy support, curriculum integration, resource provision, industry involvement, production management, quality control, student competence, and program sustainability. Observation sheets were used to record the practical condition of workshops, learning activities, equipment use, production flow, student participation, teacher supervision, and product handling. Documentation sheets were used to examine supporting evidence, such as school program documents, partnership records, Teaching Factory schedules, production records, learning modules, and related administrative files. Data collection followed the sequential explanatory logic, in which questionnaire data were collected first and qualitative data were collected afterward to clarify the quantitative findings (Draucker et al., 2020). Semi-structured interviews were used because they allow predetermined questions and flexible probing during field inquiry (DeJonckheere and Vaughn, 2019). Instrument preparation included indicator mapping, expert judgment, revision, field data collection, and source checking. Content validity was established through construct validation via expert judgement (consultation with the supervising committee and subject-matter experts), followed by an empirical item-total (Pearson product-moment) correlation try-out administered at SMK Teknik Paba Binjai to 9 teachers and 30 students prior to the main data collection; items were retained when $r > .666$ (teacher instrument) or $r > .30$ (student instrument). This process yielded 14 valid Context, 14 valid Input, 16 valid Process, and 14 valid Product items for the teacher instrument, and 13 valid Context, 16 valid Input, 15 valid Process, and 15 valid Product items for the student instrument. Internal-consistency reliability was estimated using Cronbach's alpha: teacher-instrument coefficients ranged from .939 (Process) to .988 (Context), and student-instrument coefficients ranged from .828 (Context) to .895 (Process) all falling in the 'very high' reliability category.

Data Analysis and Trustworthiness

Quantitative data were analyzed using descriptive statistics to evaluate the implementation level of the Teaching Factory program across the Context, Input, Process, and Product components. Questionnaire responses from teachers and students were coded, tabulated, and summarized through frequency, percentage, mean, median, mode, and standard deviation. Indicator achievement was calculated by comparing empirical scores with ideal scores and then interpreting the results into five categories: very good, good, fairly good, poor, and very poor. Achievement percentages reported in Figure 3 were calculated by dividing each component's empirical mean score by its ideal (maximum possible) score for that instrument and multiplying by 100, following standard CIPP scoring conventions (Stufflebeam & Zhang, 2017). This procedure enabled the study to identify the relative strength of each CIPP component and to compare teacher and student perceptions systematically. Qualitative data from interviews, observation, and documentation were analyzed through data condensation, data display, conclusion drawing, and verification, following the interactive logic of Miles et al. (2019). NVivo was used to support coding, organize field evidence, identify recurring themes, and compare patterns across schools, participants, and data sources. The qualitative analysis was then used to explain quantitative trends, thereby strengthening the connection between statistical results and contextual evidence obtained during fieldwork activities in each participating vocational school for final interpretation.

Trustworthiness was strengthened through source triangulation, method triangulation, member checking, and transparent documentation of the analytic process. Source triangulation involved comparing evidence from teachers, students, school principals, vice principals, heads of expertise programs, and industry partners. Method triangulation was applied by cross-checking questionnaire results with interview transcripts, observation notes, and relevant school documents, including program records, Teaching Factory schedules, partnership files, and production evidence. Member checking was conducted by confirming key interpretations with selected informants to reduce misinterpretation and ensure that the findings reflected actual field conditions (Stahl & King, 2020; McKim, 2023). The integration of quantitative and qualitative findings was conducted at the interpretation stage in accordance with the explanatory sequential mixed-methods design. Quantitative results first described the implementation pattern, while qualitative findings clarified why certain CIPP components showed stronger or weaker performance. This process produced a more credible evaluation of Teaching Factory implementation and its improvement priorities in the selected vocational schools. Thus, the final interpretation remained grounded in measurable evidence, stakeholder confirmation, and direct observations of Teaching Factory practice across studied sites.

Table 3. Summary of CIPP-Based Teaching Factory Evaluation Indicators

CIPP Component	Core Evaluation Focus	Main Indicators	Data Sources
Context	Program relevance and institutional support	School support for Teaching Factory, industry involvement, curriculum or department alignment, community and parental support, student motivation, perceived benefits, and work-readiness relevance	Teachers, students, school leaders, and industry partners
Input	Readiness of resources and program support	Availability of equipment, practical materials, workshop facilities, teacher competence, teacher training or internship experience, funding support, work guidelines, task division, time allocation, and industry support	Teachers, students, vice principals, heads of expertise programs, and documentation
Process	Implementation and management of Teaching Factory activities	Balance between theory and practice, real production activities, student task distribution, teacher supervision, monitoring and feedback, product quality standards, product improvement, implementation constraints, industry role, and additional teacher support	Teachers, students, observation, interviews, and program documents
Product	Learning outcomes and program impact	Improvement of student skills, student confidence, work attitude, teamwork, discipline, product use or sales, readiness for internship and competency tests, industry exposure, school–industry relationship, and school image	Teachers, students, school leaders, industry partners, and documentation

Results and Discussions

Quantitative Profile of Teaching Factory Implementation

The quantitative profile provides an initial picture of how the Teaching Factory program was implemented across the selected Vocational Centers of Excellence in Binjai City. As shown in Table 1, the study involved three private vocational schools: SMK Swasta Putra Anda Binjai, SMK Swasta Setia Budi Binjai, and SMK Swasta Teknik Paba Binjai. All schools had implemented Teaching Factory under the Vocational Center of Excellence program and received funding in 2023. Their implementation status was classified as Category 1, which means that Teaching Factory was mainly directed toward the fulfilment of students' hard skills and soft skills rather than wider community production or stable industry-based production. This position is also supported by Table 2, where Category 1 includes five basic indicators: student skill orientation, workplace-standard product quality, school-based production needs, internal product use, and limited production capacity. The local employment context in Figure 1 strengthens the relevance of this evaluation. Vocational high school graduates in Binjai recorded the highest open unemployment rate in August 2024, reaching 8.14%, while elementary-school graduates recorded 3.68%. The vocational unemployment rate also increased by 0.48 percentage points from the previous year. These data suggest that Teaching Factory implementation should be read not only as a school program but also as a response to the local employability gap, especially when vocational graduates still face difficulty entering the labour market. These regional unemployment figures describe the broader labour-market context rather than a statistically tested effect of Teaching Factory implementation on graduate employment; the program-level findings on Teaching Factory implementation quality are reported separately in Table 4 through Table 6 and should not be read as an inferential test linking the two data sources.

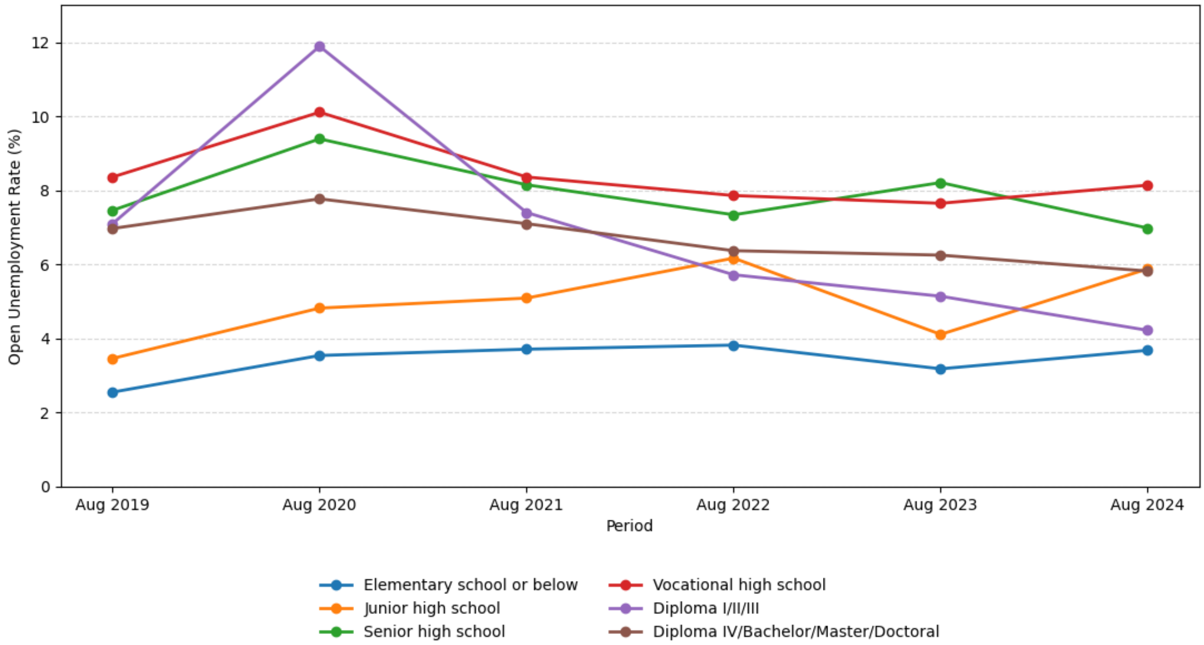

Figure 1. Open unemployment rate by educational attainment in Binjai City from August 2019 to 2024

The CIPP-based quantitative results in Table 4 and Figure 3 show that teachers and students generally perceived Teaching Factory implementation positively, although several components still require careful interpretation. From the teacher responses, the Context component obtained a mean score of 57.67, with a median of 51, mode of 70, standard deviation of 11.98, highest score of 70, and lowest score of 42. The Input component obtained a mean score of 58.33, while the Process component reached the highest raw mean score of 66.55. This process score reflects positive teacher perception of production-based learning, practice-theory balance, supervision, coordination, and quality control. The Product component obtained a teacher mean score of 56.77, with a median of 55, mode of 65, standard deviation of 8.78, highest score of 65, and lowest score of 44. Student responses showed a more differentiated pattern. The Context component reached a mean score of 54.96, the Input component 55.18, the Process component 58.04, and the Product component 59.95. The dominant response category was Very Appropriate among teachers across all four components (44.45%), and among students for Context (55.47%) and Product (36.72%); students' dominant rating for Process was Appropriate (33.60%), and notably their dominant rating for Input was Less Appropriate (37.50%), the only sub-threshold result recorded in this study. This finding aligns with Yoto et al. (2024), who reported that CIPP is useful for identifying feasibility and improvement needs in Teaching Factory implementation. It also supports Wijanarka et al. (2023), who emphasized that successful Teaching Factory implementation depends on the integration of learning process, production standards, and school capacity. Ratnaya et al. (2022) argued that CIPP is suitable for vocational education evaluation because it captures context, resources, implementation, and outcomes. Kautsar et al. (2022) also highlighted that Teaching Factory requires system management, workshop readiness, industry partnership, and product-based learning. Wahjusaputri et al. (2020) showed that Teaching Factory learning media can strengthen vocational learning outcomes when learning activities are connected with practical production experience.

Table 4. CIPP-Based Evaluation Results of Teaching Implementation in Vocational Centers of Excellence

CIPP Component	Key Evaluation Indicators	Teacher-Based Result	Student-Based Result	Main Interpretation	Improvement Focus
Context	School support, industry involvement, curriculum alignment, community support, student motivation	Mean = 57.67; dominant category = Very Appropriate, 44.44%	Mean = 54.96; dominant category = Very Appropriate, 55.47%	TEFA is contextually relevant, but industry alignment still needs strengthening	School–industry alignment
Input	Equipment, materials, facilities, teacher competence, funding, guidelines, industry support	Mean = 58.33; dominant category = Very Appropriate, 44.44%	Mean = 55.18; dominant category = Less Appropriate, 37.50%	Resource readiness diverges sharply by respondent group: teachers rate it positively, but students -- as direct end-users -- rate Input as the weakest of the four components, pointing to a teacher-student perception gap	Facilities, funding, teacher training
Process	Production-based learning, practice-theory balance, supervision, coordination, quality control	Mean = 66.55; dominant category = Very Appropriate, 44.44%	Mean = 58.04; dominant category = Appropriate, 33.60%	The process is the strongest component, especially in practical learning and teacher guidance	Scheduling, SOP, quality control
Product	Student skills, confidence, work attitude, product use, marketing, certification, school image	Mean = 56.77; dominant category = Very Appropriate, 44.44%	Mean = 59.95; dominant category = Very Appropriate, 36.72%	TEFA improves student competence, but product competitiveness and certification still require improvement	Product marketing and certification

Context Evaluation: Program Relevance and School–Industry Alignment

The context evaluation examined whether the Teaching Factory program was relevant to school goals, student needs, community expectations, and industry demand. As shown in Table 4, the context component covered five main indicators: school support, industry involvement, curriculum alignment, community and parental support, and student motivation. The teacher-based result showed a mean score of 57.67, with a median of 51, mode of 70, standard deviation of 11.98, highest score of 70, and lowest score of 42. The dominant teacher response was classified as Very Appropriate, but only 44.44% of teachers were in this category. Student responses showed an even stronger pattern, with a mean score of 54.96 (median = 58, mode = 65, SD = 8.65, range 27–66) and 55.47% of students classified in the Very Appropriate category. This contrast suggests that students experienced Teaching Factory as relevant to their learning needs, while teachers may have evaluated the program more critically because they understood institutional readiness, curriculum integration, and industry involvement more directly. Figure 3 also supports this pattern, where the context score reached 82.4% for teachers and 84.6% for students after score normalization. Ratnaya et al. (2022) stated that the context dimension in CIPP evaluation is useful for examining program needs and institutional relevance. Yoto et al. (2024) also used the context component to assess whether Teaching Factory implementation was aligned with vocational school needs and student skill development.

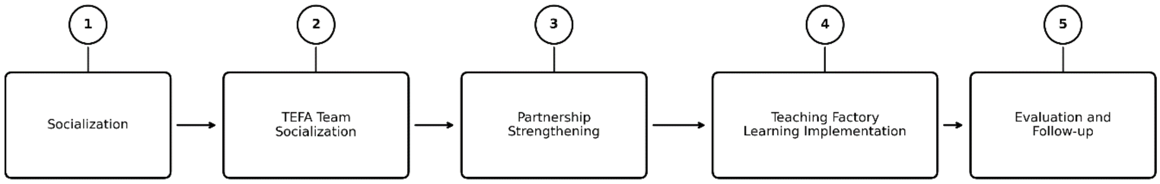

Figure 2. Development stages of Teaching Factory implementation in Vocational Centers of Excellence

The context findings also need to be read in relation to the implementation maturity described in Table 1, Table 2, and Table 5. The three schools were classified as Category 1 Teaching Factory implementers, meaning that the program mainly focused on fulfilling students' hard skills and soft skills. At this level, production activities were still directed toward school-based learning rather than wider community use or stable industry

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partnership. This status explains why the context component was generally positive but still required improvement in school–industry alignment. The qualitative synthesis in Table 5 shows that the program was relevant to vocational education goals and student work-readiness development, yet the connection with industry demand was not fully optimized. This finding is consistent with Estriyanto (2021), who emphasized that vocational education needs a demand-driven partnership pattern between schools and industry. Wijanarka et al. (2023) found that Teaching Factory success depends on more than school-level implementation because industry standards and institutional commitment strongly affect program quality. Kautsar et al. (2022) also highlighted that Teaching Factory development requires system management, industry partnership, and clear institutional support. In this study, the context component was not weak, but it still reflected a program that was stronger as a school learning strategy than as a mature industry-linked production model.

Input Evaluation: Resource Readiness and Institutional Support

The input evaluation examined the readiness of resources that supported Teaching Factory implementation in the three Vocational Centers of Excellence. As shown in Table 3, the input component covered equipment availability, practical materials, workshop facilities, teacher competence, teacher training or internship experience, funding support, work guidelines, task division, time allocation, and industry support. The quantitative result in Table 4 shows that the teacher-based input score reached a mean of 58.33, with the dominant category classified as Very Appropriate at 44.44%. Student responses showed a markedly different pattern: the input component obtained a mean score of 55.18 (median = 54, mode = 61, SD = 7.99, range 39–72), with the dominant response category being Less Appropriate at 37.50% the only component in this study where students' dominant rating fell below the "Appropriate" threshold. In Figure 3, the normalized input achievement score reached 83.3% for teachers but only 69.0% for students, the lowest achievement percentage recorded across all eight teacher/student × CIPP-component combinations. This divergence points to a perception gap rather than convergent evidence of adequate resourcing: teachers appear to assess input readiness against administrative indicators such as start-up grant availability, completed teacher training, and curriculum alignment with national competency standards, whereas students, as direct end-users, report a mismatch between the ratio of practical equipment and student numbers and a technology gap between school workshops and current industry standards. The result is consistent with Ratnaya et al. (2022), who argued that the input component in the CIPP model is important for evaluating whether educational resources are sufficient to support program objectives. Yoto et al. (2024) also emphasized that Teaching Factory feasibility depends on input readiness, including facilities, human resources, and learning support. In this study, the input component emerged as the clearest gap between policy-level resourcing and field-level experience: while teachers perceived input readiness positively, students identified it as the weakest of the four CIPP components, underscoring equipment standardization and facility capacity as the most urgent improvement priority.

The input findings become clearer when connected with the qualitative synthesis in Table 5. The table shows that resource readiness was generally supportive, but several components remained uneven across schools. The main issues included equipment standardization, raw material availability, teacher training, funding, and production facilities. These findings are important because all three schools were positioned in Category 1 in Table 1 and Table 2, which means that Teaching Factory was still mainly used for student competency fulfilment. At this stage, tools and facilities may be sufficient for school-based practice but not yet strong enough for wider production or industry-linked operations. Kautsar et al. (2022) showed that Teaching Factory development requires strong system management, workshop readiness, financial governance, and industry partnership. Saputro et al. (2023) also found that Teaching Factory implementation in Indonesian vocational education was constrained by human resources, infrastructure, and industry collaboration. Wijanarka et al. (2023) further explained that successful Teaching Factory implementation requires alignment between production standards, school capacity, and institutional commitment. In the present study, the positive input score indicates that the basic resources were already available, but improvement is still needed in equipment upgrading, transparent funding management, regular teacher internships, and stronger industry-supported input planning.

Process Evaluation: Production-Based Learning and Quality Control

The process evaluation examined how Teaching Factory was implemented as production-based learning in the selected Vocational Centers of Excellence. As presented in Table 3, the process component covered the balance between theory and practice, real production activities, student task distribution, teacher supervision, monitoring and feedback, product quality standards, product improvement, implementation constraints, industry role, and additional teacher support. The quantitative result in Table 4 shows that the teacher-based process score reached a mean of 66.55, with the dominant category classified as Very Appropriate at 44.44%. Student responses showed a more moderate pattern, with a mean score of 58.04 (median = 58.5, mode = 60, SD = 8.66, range 37–74) and a dominant category of Appropriate at 33.60% one category step below the teachers' dominant Very Appropriate rating. In Figure 3, the process achievement reached 83.2% for teachers (calculated from the 16-

item teacher instrument, ideal score = 80) and 77.4% for students (calculated from the 15-item student instrument, ideal score = 75). This pattern suggests that, unlike the Input component, teachers rated the Process component more positively than students did; teachers directly oversee supervision, scheduling, coordination, and quality control, whereas students appear to experience the day-to-day inconsistencies in these areas more directly as participants in production activities. Yoto et al. (2024) found that the process component in Teaching Factory evaluation is closely related to the quality of learning implementation and student skill development. Saputro et al. (2023) also reported that Teaching Factory implementation in Indonesian vocational education requires consistent process management because production-based learning is affected by infrastructure, human resources, and industry collaboration.

The process result should also be interpreted through Figure 2 and Table 5. Figure 2 shows that Teaching Factory development follows staged activities from socialization, TEFA team organization, partnership strengthening, learning implementation, and evaluation. This sequence is important because the process component does not only measure classroom practice. It also measures how the school organizes production flow, supervision, industrial standards, and follow-up improvement. Table 5 strengthens this interpretation by showing that production-based learning had been implemented and gave students practical experience, but the process still faced barriers related to scheduling, coordination, production continuity, and product quality control. This condition is consistent with the status of the three schools in Table 1 and Table 2, where all schools were still classified as Category 1 implementers. Category 1 indicates that TEFA mainly served student competency fulfilment, not wider community production or stable industry-based production. Wijanarka et al. (2023) emphasized that successful TEFA requires the integration of learning process, production standards, and school capacity. Kautsar et al. (2022) highlighted the need for system management, block scheduling, worksheets, products or services, workshops, and industry partnership. Wahjusaputri et al. (2020) showed that TEFA-based learning media can improve vocational learning outcomes when students receive structured guidance and practical production experience.

Product Evaluation: Student Competence, Product Outcomes, and School Image

The product evaluation examined the learning outcomes and institutional effects produced by Teaching Factory implementation. As shown in Table 3, the product component covered student skill improvement, student confidence, work attitude, teamwork, discipline, product use or sales, internship readiness, competency-test readiness, industry exposure, school–industry relationship, and school image. Based on the summarized CIPP profile used in Figure 3, the product achievement reached 81.1% for teachers and 79.9% for students. These values indicate that both respondent groups perceived the product dimension positively, especially in relation to students' competence and learning outcomes. The teacher result suggests that product achievement was positive but still lower than the process component, which indicates that implementation activities were stronger than output consolidation. The student result suggests that learners experienced direct benefits from TEFA through improved skills, confidence, teamwork, and work discipline. This interpretation is aligned with Yoto et al. (2024), who found that product evaluation in Teaching Factory is closely related to students' practical skills and program feasibility. Wahjusaputri et al. (2020) also reported that Teaching Factory learning media can strengthen vocational learning outcomes when students are connected with practical production experience. In this study, the product component showed that TEFA had supported competence formation, but the transformation from school-based learning products into competitive market outputs still required further strengthening.

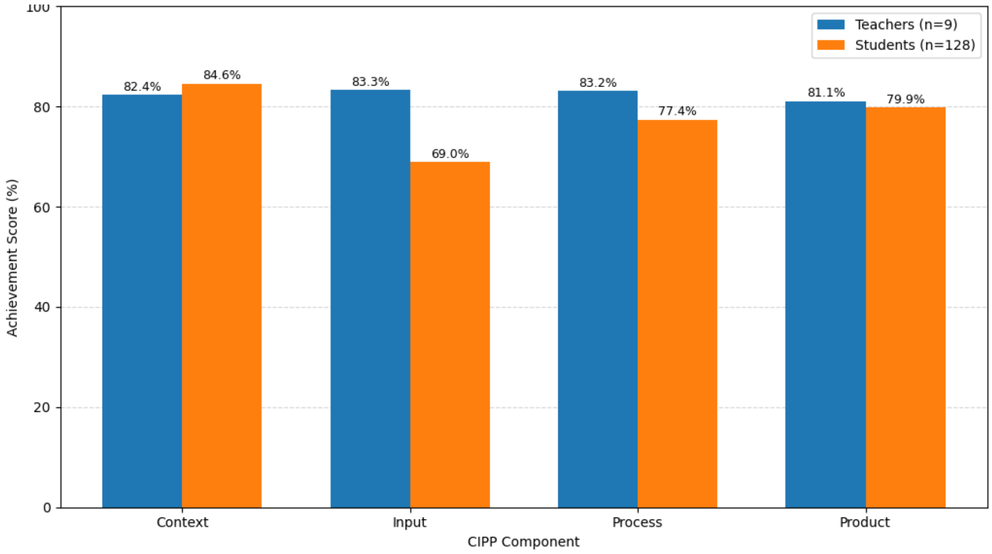

Figure 3. Summary of Teacher and Student Achievement Scores Across Context, Input, Process, and Product Components

The product findings need to be interpreted together with Table 1, Table 2, and Table 5. The three schools were still classified as Category 1 implementers, which means that TEFA mainly focused on fulfilling students' hard skills and soft skills rather than producing goods or services for wider community demand or stable industry partnership. This maturity level explains why the product component showed positive learning outcomes but still revealed weaknesses in product competitiveness, marketing, certification, and wider market access. The qualitative synthesis in Table 5 shows that TEFA contributed to students' technical skills, work attitude, discipline, and confidence. The same table also shows that student products were not yet consistently competitive in quality, price, certification, and market reach. This pattern is important because a mature Teaching Factory should not only improve students' skills but also expose them to product standards, customer expectations, and external validation. Wijanarka et al. (2023) emphasized that successful TEFA requires alignment between learning activities, production standards, and institutional capacity. Kautsar et al. (2022) highlighted that Teaching Factory development requires system management, products or services, workshop readiness, and industry partnership. Saputro et al. (2023) also showed that CIPP-based TEFA evaluation can identify gaps in implementation outcomes and help schools design improvement strategies. In this study, the strongest product contribution was student competence development, while the main improvement priority was moving TEFA products from internal school use toward certified, market-tested, and industry-recognized outputs.

Table 5. Integrated Mixed-Methods Findings and Improvement Priorities for Teaching Factory Implementation

Evaluation Component	Integrated Mixed-Methods Finding	Main Supporting Evidence	Improvement Priority	Suggested Action for Program Strengthening
Context	The Teaching Factory program was relevant to vocational education goals, school needs, and student work-readiness development. However, the connection with industry demand was not yet fully optimized.	Questionnaire findings showed generally positive responses from teachers and students. Interview and observation data indicated that industry involvement, school vision alignment, and community support still needed stronger implementation.	Strengthening school–industry alignment	Involve industry partners in curriculum synchronization, product planning, competency mapping, and periodic program evaluation.
Input	Resource readiness was generally supportive, but several input	Quantitative data indicated that the input component was rated positively. Qualitative	Improving facilities, funding, and teacher competence	Upgrade workshop equipment, prepare raw-material planning, allocate

Evaluation Component	Integrated Mixed-Methods Finding	Main Supporting Evidence	Improvement Priority	Suggested Action for Program Strengthening
	components remained uneven across schools. These included equipment standards, raw material availability, teacher training, funding, and production facilities.	findings showed that several tools did not fully match industry standards and teacher mastery of updated production technology still required improvement.		transparent TEFA funding, and conduct regular teacher internships or industry-based training.
Process	Production-based learning had been implemented and gave students practical experience. The process still faced barriers related to scheduling, coordination, production continuity, and product quality control.	Teacher and student responses showed positive perceptions of the learning process. Field findings indicated that TEFA activities sometimes overlapped with regular learning schedules and quality control mechanisms were not yet consistently applied.	Improving learning management and quality control	Apply block scheduling, develop standard operating procedures, assign clear production roles, and use product quality checklists based on industry standards.
Product	TEFA contributed to students' technical skills, work attitude, discipline, and confidence. Product competitiveness, marketing, certification, and wider market acceptance were still limited.	Questionnaire results reflected positive student outcomes. Interview and observation data showed that student products were not yet consistently competitive in quality, price, certification, and market reach.	Strengthening product competitiveness and student certification	Develop product branding, market testing, industry-recognized skill certification, customer feedback systems, and product improvement cycles.
Governance and Management	TEFA implementation was still strongly school-based and had not fully operated as a managed production system. Financial administration, documentation, and regulation were identified as weak areas.	Qualitative data highlighted unclear financial governance, limited administrative transparency, and weak regulatory direction for TEFA operations.	Improving institutional governance	Establish a TEFA management unit, prepare financial records, create production documentation, and define responsibility among school leaders, teachers, and program teams.
Implementation Maturity	The three schools were positioned in **Category 1**, meaning that TEFA mainly focused on fulfilling students' hard skills and soft skills. The program had not yet reached a stronger community-based or industry-partnership production model.	This study classified the selected Vocational Centers of Excellence in Binjai City as Category 1 Teaching Factory implementers.	Moving from competency fulfilment to industry partnership	Gradually expand production from internal school needs to customer orders, community use, financial administration, joint production with partners, and stable industry-linked production.

Integrated Mixed-Methods Findings and Improvement Priorities

The integrated mixed-methods findings show that Teaching Factory implementation in the three Vocational Centers of Excellence was generally feasible, but the program had not yet reached a mature industry-partnership model. As shown in Table 1, all three schools implemented Teaching Factory under the Vocational Center of Excellence program with funding in 2023. Table 2 classifies the schools as Category 1, meaning that implementation mainly focused on fulfilling students' hard skills and soft skills. This classification is important because the quantitative results in Table 4 and Figure 3 show positive perceptions, but the qualitative findings in Table 5 explain why the program still needs improvement. Teacher achievement scores were 82.4% for Context, 83.3% for Input, 83.2% for Process, and 81.1% for Product a consistently high and comparatively flat profile across all four components. Student scores were more differentiated: 84.6% for Context, 77.4% for Process, and 79.9% for Product, but only 69.0% for Input, the single lowest score recorded in this study and the clearest quantitative signal of the teacher–student perception gap described above. These results indicate that students experienced TEFA as useful and practical in most respects, but were considerably more critical than teachers specifically on resource and facility readiness a divergence the qualitative findings below help to explain. Yoto et al. (2024) also found that CIPP-based Teaching Factory evaluation is useful for identifying feasibility and improvement needs in vocational schools. Saputro et al. (2023) reported that Teaching Factory implementation in Indonesian vocational education often remains constrained by infrastructure, human resources, and industry collaboration. The present findings show a similar pattern because positive scores were accompanied by resource, governance, scheduling, and partnership limitations.

The improvement priorities in Table 5 show six main directions for strengthening Teaching Factory implementation: school–industry alignment, facilities and teacher competence, learning management and quality control, product competitiveness and certification, institutional governance, and implementation maturity. These priorities reflect the gap between positive program acceptance and the need for stronger production-oriented management. The context finding shows that industry demand was not fully optimized, even though the program was relevant to vocational goals. The input finding shows that resource readiness was supportive, but equipment standards, raw materials, teacher training, funding, and production facilities remained uneven. The process finding shows that production-based learning gave students practical experience, but scheduling, coordination, production continuity, and quality control still required improvement. The product finding shows that TEFA supported students' technical skills, work attitude, discipline, and confidence, but product competitiveness, marketing, certification, and wider market access remained limited. Wijanarka et al. (2023) emphasized that successful TEFA implementation requires alignment between learning processes, production standards, and school capacity. Kautsar et al. (2022) highlighted that a sustainable Teaching Factory model requires workshop readiness, system management, product or service development, and industry partnership. Wahjusaputri et al. (2020) showed that TEFA-based learning can improve student outcomes when practical production experience is supported by structured learning media. These studies support the interpretation that the next development stage should move TEFA from competency fulfilment toward certified, market-tested, and industry-recognized production.

Table 6. Qualitative Themes Supporting CIPP-Based Evaluation Results

Process Evaluation Indicator	Operational Focus	Teacher-Based Evidence	Student-Based Evidence
Proportion of practice and theory	Balance between hands-on production activities and classroom theory	Assessed through teacher responses on the extent to which TEFA emphasizes practical learning	Assessed through student responses on whether TEFA provides more practical experience than theory
Real production activities	Production of goods or services that can be used, ordered, or sold	Teachers assessed whether TEFA activities involved real production and customer-oriented tasks	Students assessed whether TEFA products were usable, sellable, and produced through industry-like procedures
Teacher supervision and evaluation	Teacher guidance, monitoring, feedback, and evaluation during production	Teachers assessed their role in mentoring, evaluating, and improving student work	Students assessed whether teachers monitored activities and provided feedback during TEFA implementation
Quality standards and product improvement	Application of product standards, corrective action, and product refinement	Teachers assessed product quality control and improvement practices	Students assessed whether TEFA products followed industrial standards and were revised when quality problems occurred
Implementation constraints	Barriers related to tools, materials, time, scheduling, and technical readiness	Teachers reported constraints related to equipment, materials, time, and implementation continuity	Students assessed whether broken tools, late materials, or insufficient practice time affected TEFA activities
Industry role in TEFA process	Industry involvement in production standards, supervision, feedback, or evaluation	Teachers assessed industry contribution during the implementation stage	Students assessed whether industry standards or guidance were introduced during TEFA activities

Process Evaluation Indicator	Operational Focus	Teacher-Based Evidence	Student-Based Evidence
Additional teacher efforts	Extra support provided by teachers to maintain program implementation	Assessed through teacher responses on additional actions taken to support TEFA activities	Reflected indirectly through students' experience of guidance, correction, and task completion
Overall teacher response	Summary of teacher perception of process implementation	Mean = 66.55; Median = 66; Mode = 73; SD = 6.96; Score range = 57–74; dominant category = Very Appropriate, 44.44%	
Overall student response	Summary of student perception of process implementation		Mean = 58.04; Median = 58.5; Mode = 60; SD = 8.66; reported score range = 37–74; dominant category = Appropriate, 33.60%

Conclusions

Relative to the four objectives set out in the Introduction, this study concludes that Teaching Factory implementation in the three Vocational Centers of Excellence in Binjai City is feasible to continue and is generally accepted by teachers and students, particularly in supporting production-based learning, student competence, work attitudes, discipline, and confidence (Process and Product objectives). This acceptance, however, coexists with substantive operational gaps against the Context and Input objectives most notably a teacher–student perception gap on resource readiness, where students rated Input as the weakest component together with equipment standardization, financial governance, production continuity, quality control, product competitiveness, certification, and market access, all of which remained below the level expected of a mature Teaching Factory model. Positive stakeholder perception should therefore not be read as evidence that Teaching Factory implementation has met industry-standard production benchmarks; rather, it indicates readiness among teachers and students to strengthen the program's most underdeveloped components. The three schools were still positioned at Category 1 (Table 2), a classification operationalized through five criteria: a focus on students' hard and soft skills, product or service quality aligned with workplace standards, production driven by school needs, internal-only product use, and limited production capacity as distinct from the community-oriented Category 2 or the industry-partnership-based Category 3. This means that Teaching Factory mainly focused on fulfilling students' hard skills and soft skills rather than developing wider community-based or industry-partnership production. Several limitations remained in equipment standardization, teacher training, financial governance, production continuity, quality control, product competitiveness, certification, and market access. This study was also limited to three private vocational schools in one city, so broader generalization requires caution. Future research should involve more schools, different vocational fields, longitudinal graduate-employment tracking, industry-validated competency certification, product sales data, and comparison between schools with different levels of Teaching Factory maturity.

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