



Development of Teaching Factory Learning Guidebooks Through Subject Integration in Vocational Schools

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Abstract

Project-based TEFA at SMK Muhammadiyah 1 Kepanjen was running and industry-synchronous, yet cross-subject integration (general ↔ vocational) had not been implemented and evaluation documents were inconsistent (~10% incomplete). This development study produced a Teaching Factory (TEFA) learning guidebook that integrates general and vocational subjects in the Motorcycle Engineering concentration using ADDIE (analysis, design, development, implementation, evaluation). Participants in a limited implementation comprised 4 expertise teachers, 3 general-subject teachers, 4 vocational-subject teachers, 10 Grade-XI students, 2 industry representatives, the principal, and the vice principal for curriculum (N=25). Instruments included design/material expert checklists and stakeholder feasibility/usability questionnaires (Likert 1–5) plus observation, interview, and documentation guides. Scale anchors, item counts, and example items are specified in Methods; internal consistency (Cronbach's α/ω) and inter-rater agreement for expert validations are reported in Results. Feasibility was high (expert means $\approx 4.6/5$) and stakeholder ratings averaged 88–94% across ease of use, relevance, completeness/integration, clarity, and practical applicability. Key improvements include integrated performance assessment (multi-rater, role-inclusive), richer cross-subject cases, and documentation consistency. Findings are feasibility-oriented and do not claim effectiveness; future work should test outcomes and employability impacts via quasi-experimental designs.

Keywords: ADDIE; guidebook; subject integration; TEFA; vocational school

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INTRODUCTION

The Teaching Factory (TEFA) is a strategic approach in vocational schools (Jamaludin et al., 2023) to bridge the gap between theory and practice in vocational education (Farran & Nunez, 2025; Siliņa-Jasjukeviča et al., 2025). This model has been widely implemented in various developed countries as a key characteristic of vocational education oriented to industry needs (Enke et al., 2020; Kreß et al., 2021; Tvenge & Ogorodnyk, 2018). For example, Germany has a vocational system called dual vocational training (Duale Ausbildung). Apprentices study at a Berufsschule (vocational school) and receive on-the-job training in a company. This system is both legal and formal, combining theory and practical experience (Schwede et al., 2025; Ulrich et al., 2022).

The advantage of the TEFA learning system is that graduates not only understand the theory, but are also familiar with industrial processes, so that the unemployment rate is low and graduates are ready to work (Barak & Shoshana, 2025; Tadesse et al., 2025; Tran et al., 2024). Specifically in Southeast Asia, Singapore has a strong vocational education system that emphasizes practical training and industry relevance. The goal is to ensure that graduates have the skills needed by industry and can contribute to the economy (Tarat & Sindecharak, 2020;

Varaprasad, 2024). In fact, in Thailand, TEFA is starting to be adapted with a culturally relevant and systemic approach, including implementation guidelines tailored to the local context (OECD, 2021; Pearnpitak & Sirisunhirun, 2023). Local needs analysis confirmed a specific problem: TEFA was project-based and industry-synchronous but not yet integrated across general and vocational subjects; evaluation documentation showed $\approx 10\%$ incompleteness, and project effectiveness lagged (90%). These deficits justified an integrative guidebook that links learning outcomes, production tasks, and assessment across subjects with explicit industry standards.

The implementation of TEFA, particularly in countries with strong vocational education systems, often serves as a model for increasing the relevance of education to industry needs. While the term "TEFA" may not always be used precisely, similar concepts focused on production-based learning and industry practice are widely implemented in various countries (Jaya et al., 2025; Pratama et al., 2025; Wibowo et al., 2025).

In the Indonesian context, Presidential Instruction No. 9 of 2016 concerning the Revitalization of Vocational High Schools (Sekolah Menengah Kejuruan or SMK) was issued with the aim of improving the quality and relevance of SMKs, and clarifying that SMK graduates are directed towards three main things: work, continuing to higher education, and entrepreneurship. To prepare students for the world of work, several steps must be taken, namely establishing partnerships with companies to understand current industry needs and opening up opportunities for internships in the industry in the form of Field Work Practices. As part of this step, the appropriate learning model is TEFA, a learning model that combines the achievement of school curriculum competencies and production processes according to procedures and standards of the world of work, to produce competent and character-based graduates through the completion of products as learning media in the form of goods and/or services (Casmudi et al., 2022).

The success of TEFA-based learning, both in Indonesia and abroad, lies in close collaboration between educational institutions and the business/industrial world. However, its implementation still faces various obstacles, such as synchronizing expertise concentrations with dynamic industry needs and the minimal involvement of general subject and vocational subject teachers in TEFA-based learning (Prianto et al., 2020; Saputro et al., 2021). Another issue is the lack of quality student products that meet industry standards. Furthermore, collaboration with industry is often a formality without concrete follow-up, and some industries still lack an understanding of the strategic role of vocational schools in preparing graduates for employment, continuing education, and entrepreneurship. Consequently, several student achievement indicators have not been optimally evaluated (Cahyani & Miyono, 2024).

This development has novelty and urgency. Nitiswito and Maksum (2021) confirmed that the development of TEFA-based teaching modules, such as those on motorcycle repair shop management, has proven valid, practical, and effective for use in vocational learning. Susilowati et al. (2024) emphasizes the importance of integrating TEFA learning with production units and adapting the school curriculum to the needs of the industrial world, so that learning becomes relevant and supports the improvement of student competencies. Adirmawan (2022) states that the TEFA-based school development strategy is expected to be able to produce projects and innovations that support the realization of Regional Public Service Agency Vocational Schools, so that learning not only produces competencies, but also real products. Research by Akyuwen et al. (2023) shows that the principal has an important role in supporting the implementation of TEFA, both as a planner, organizer, implementer, supervisor, and motivator, to create a conducive and productive learning environment.

Overall, these studies confirm that the success of TEFA implementation is influenced by the quality of planning, support from school management, integration with the industrial world, the provision of real-world practice facilities, and structured and relevant learning modules. Collaboration between stakeholders and the commitment of school principals are determining

factors in the successful development and implementation of TEFA-based learning models in vocational schools (Akyuwen et al., 2023; Islami et al., 2021; Kareem et al., 2024; Ozdemir et al., 2023; Truong et al., 2025).

In this regard, one of the vocational schools that has received attention is SMK Muhammadiyah 1 Kepanjen, Malang Regency. SMK Muhammadiyah 1 Kepanjen has unique characteristics as an educational institution based on Islamic values and a productive work culture, and has actively implemented various partnership programs with industry. These characteristics are a strong motivation to design an integrated TEFA learning guidebook, which is able to answer the internal needs of the school as well as the external challenges of the industrial world. This integration can be realized in one of the vocational subjects such as Creative Projects and Entrepreneurship will provide material on business planning, digital marketing in learning so that it will encourage students to improve their productive work attitudes and independence of vocational school students. This integration is operationalized within the Creative Products and Entrepreneurship subject through: (i) clearly mapped learning outcomes (e.g., business planning, digital marketing), and (ii) production-oriented tasks that require cross-subject inputs (technical reporting in Bahasa Indonesia, costing with Mathematics, digital documentation with Informatics, and ethics/OHS via Religious and Character Education).

From several previous researchers, the research conducted at SMK Muhammadiyah 1 Kepanjen is to develop a guidebook that not only focuses on technical competencies, but also strengthens the integration between vocational curriculum, general subjects, and the demands of the 21st century workplace, including strengthening soft skills and student character. This guidebook is different from the previous TEFA guidebook because this guidebook combines planning, implementation, and evaluation of learning in an integrated manner—by involving all parties, including general subject teachers, vocational subject teachers, and industry. Thus, the novelty of this research is to develop a TEFA learning guidebook that integrates general subjects and vocational subjects, this research is expected to improve the quality of the learning process, optimize student engagement, and increase student readiness in facing the workplace and the maximum involvement of industry. This guidebook will also be an important reference for teachers in implementing adaptive and innovative learning strategies and will be useful for other schools that apply the TEFA learning model to produce standard products with industry needs. To substantiate novelty beyond narrative claims, we provide a 1-page comparison contrasting this guidebook with prior TEFA products on five dimensions: cross-subject integration, authentic multi-rater assessment, SKKNI/certification mapping, OHS/ethics coverage, and industry co-assessment. This matrix demonstrates how the present guidebook uniquely combines planning–implementation–evaluation with genuine involvement of general/vocational teachers and industry.

The objectives of this study are twofold. First, it aims to develop a guidebook for the Teaching Factory (TEFA) learning model through its integration into the Motorcycle Engineering expertise concentration at SMK Muhammadiyah 1 Kepanjen. Second, it seeks to analyze users' responses toward the developed guidebook, particularly in terms of its relevance, practicality, and effectiveness in supporting the implementation of TEFA-based learning within the vocational education context.

This research is expected to make several significant contributions. For schools and teachers, the development of a guidebook will provide a systematic and practical framework to implement TEFA-based learning, particularly in the Motorcycle Engineering expertise concentration at SMK Muhammadiyah 1 Kepanjen. The guidebook is designed to enhance student active participation, foster integration across subjects, and ensure the relevance of learning materials to industry needs. For the business and industrial sectors, this study strengthens partnerships between vocational schools and industry through active collaboration, direct mentoring, guest lecturing, and the provision of industrial practice opportunities. Beyond

its practical application in SMK Muhammadiyah 1 Kepanjen, the research also offers broader contributions to improving the overall quality of vocational education. Furthermore, it supports the enhancement of students' competencies, both technical and non-technical, as demonstrated through project-based assessments, industrial internships, and competency tests.

METHOD

Research Approach and Design

The research approach used is a development research design. This approach aims to produce a product in the form of a TEFA learning guidebook based on integration with general and vocational subjects relevant to the Motorcycle Engineering expertise concentration at SMK Muhammadiyah 1 Kepanjen. In this development research, the researcher used the ADDIE Model. The name ADDIE is an acronym for the five stages that make up this process: Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009). The ADDIE model was chosen because it is a systematic approach designed to develop learning programs effectively. Each stage produced specific outputs: (1) *needs analysis* identified integration gaps; (2) *design* produced the integration blueprint and assessment plan; (3) *development* yielded guidebook drafts validated by experts; (4) *implementation* conducted limited trials with teachers, students, and industry; and (5) *evaluation* summarized quantitative and qualitative validation data leading to revisions.

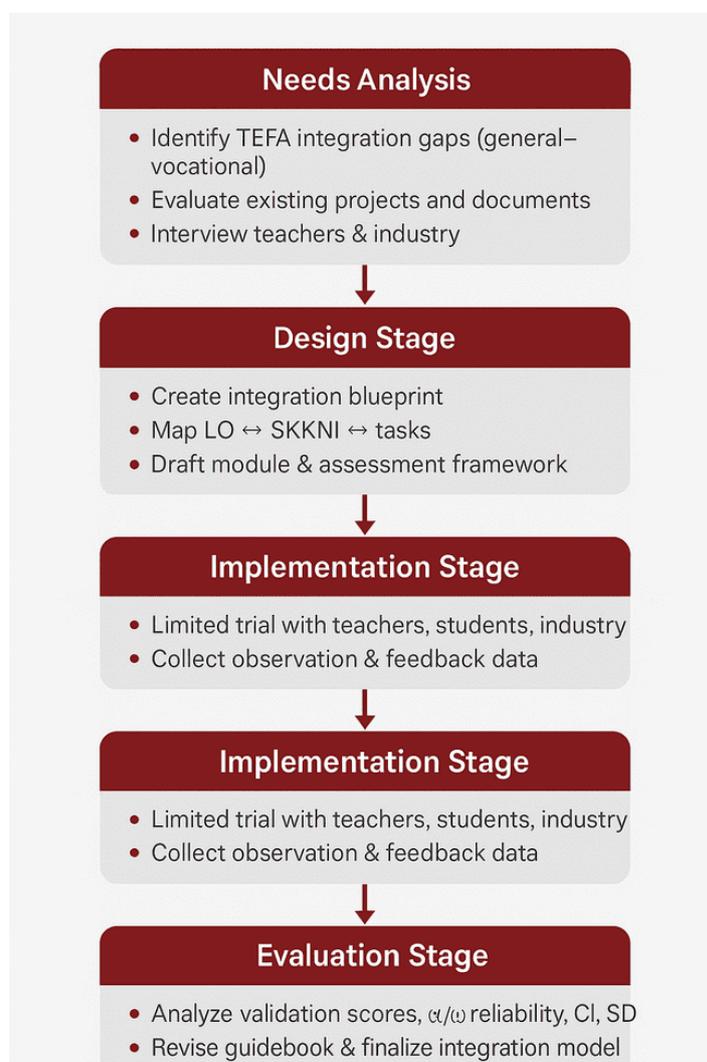


Figure 1. Stages and deliverables of the ADDIE model used in developing the integrative TEFA guidebook

The advantages of ADDIE are its flexibility that allows revisions at each stage, as well as its ability to ensure that learning outcomes are in line with predetermined objectives. This model is suitable for the development of educational products such as guidebooks, learning modules, or competency-based programs. To support this, it is explained in Table 1.

Table 1. Development Stages using the ADDIE Model

Main Focus	ADDIE Stages	Information
The process of compiling a book	Analysis Stage: Analysis of needs, school conditions, and curriculum regarding the guidebook	Conducted through observation, in-depth interviews, and documentation.
	Design Stage: Planning the content of the guidebook and integration between subjects.	The design includes a cover, a list of chapters, and subchapters to outline the book's contents. The format of the book, presented in printed form, is based on the results of the previous analysis.
	Development Stage: Preparation and production of guidebooks.	At this stage, the focus is on identifying TEFA products, synchronizing materials between expertise concentrations and the business and industrial worlds, analyzing Learning Outcomes by general and vocational teachers, compiling learning and assessment plans in the form of teaching modules and job sheets.
Implementation of the book in the field and user response	Implementation Stage: Examining how books are used by teachers/students in learning	User pilot testing of the guidebook. This stage tested the applicability of the material developed in the TEFA learning scenario through the integration of general and vocational subjects in the TEFA workshop, and documented this in a 10-minute simulation video.
	Evaluation Stage: Examine whether the guidebook is useful and meets user needs.	Assess the learning material guidebook ready for implementation according to the plan outlined in the Teaching Module and Jobsheet. Evaluation is conducted to ensure that the developed product meets user objectives. This stage gathers user feedback.

Research Subjects

The research subjects directly involved in the limited trial are as follows: 4 Expertise Concentration Teachers as facilitators for TEFA learning through the integration of general and vocational subjects in the Motorcycle Engineering concentration; 3 General Teachers: Islamic Religion, Indonesian Language, and Physical Education, Sports, and Health; 4 Vocational Teachers: Family Welfare, Mathematics, Informatics, and Science; 10 regular students in the Motorcycle Engineering concentration, grade XI/Phase F, who will implement learning activities according to the scenario; 2 industry experts who will provide assessments; and the Principal who will be involved in supervising the learning. Furthermore, research informants are parties who provide critical information to support the guidebook development process. These informants include graphic design experts, guidebook content experts, material experts (curriculum, head of the expertise concentration, teachers of the expertise and industry concentrations), and 2 education practitioners who will serve as guidebook validators.

Limited-trial stakeholders were 4 expertise teachers, 3 general-subject teachers, 4 vocational-subject teachers, 10 students (Grade XI, Phase F), 2 industry representatives, the principal, and the vice principal for curriculum (N=25). Eligibility: active at SMK Muhammadiyah 1 Kepanjen or partner industry; for students, parental consent and school permission were required. Recruitment used school/industry invitations based on role relevance. Ethics: the study obtained institutional approval (ID: to be provided); all adult participants consented; student assent and parental consent were secured.

Data Types and Sources

A qualitative approach was used to explore the needs, constraints, and potential of TEFA learning integration, obtained through observation, interviews, and documentation. A descriptive quantitative approach was used to describe the results of the product feasibility assessment using a questionnaire/validation sheet by user experts. Data sources included: expert informants: graphic design experts, subject matter experts (curriculum, teachers in specialization, and industry), two education practitioners acting as validators, teachers and students as the primary users of the guidebook, supplementary documents such as learning outcomes, teaching modules, and learning observation notes.

Data Collection Techniques and Techniques

In accordance with the ADDIE research approach, data collection was conducted according to the ADDIE stages. The Analysis stage involved observations and interviews to determine the needs and characteristics of users of the guidebook, focusing on teachers, students, and the business and industrial sectors. The Design stage involved document studies and observations to design the product concept (cover, book content, layout, and language). Two design experts participated. The Development phase involved a questionnaire administered to expert material and media validators, as well as an initial user review to develop the guidebook and conduct expert validation. This involved the Principal, Vice Principal for Curriculum, Head of Expertise Concentration, the business and industrial sectors, teachers, and students. This was conducted to determine the motorcycle engineering service analysis that would be used in TEFA learning, analyzing the most essential and contextual learning objectives of general and vocational subjects. The Implementation phase involved an assessment questionnaire and user response interviews through a limited product trial, involving four expertise concentration teachers, three general teachers, four vocational teachers, the business and industrial sectors, and the principal, conducted during the Performance Test. The Evaluation phase involved observation and feedback from users aimed to evaluate the final quality of the product.

Based on these data collection methods, the research instruments were: a. the researcher as the main instrument, tasked with designing, collecting, analyzing, and interpreting data; b. Observation Guide or observation checklist; c. Interview Guide; d. Documentation study guide; e. Assessment questionnaire; and f. Field notes are the researcher's notes about unexpected events in the field, the social context, and dynamics not captured by other instruments. The goal is to document each observation and interview in greater detail.

Instruments & Procedures

1. Expert validation checklists (design; material)—constructs: cover/layout/readability/structure/visuals (design); alignment to SKKNI, learning objectives specificity, plan relevance, authentic assessment (material). Scales: 1 (poor)–5 (excellent). Items: design=5; material=5. Example item (material): “Learning plans are relevant, essential, and contextual to analysis.” Rater training: brief rubric familiarization; inter-rater agreement computed for experts.
2. Stakeholder feasibility/usability questionnaire—constructs: ease of use, relevance, completeness & integration, clarity, practical applicability; scale: 1–5 converted to %; role-tagged to enable descriptive comparisons (teachers / general / vocational / leadership / industry).
3. Observation/Interview/Documentation guides—structured to capture integration practices, OHS/ethics presence, and documentation completeness. Procedures followed ADDIE stages; the 10-minute TEFA simulation generated checklist scores and field notes informing revisions. Appendix 1 lists all instruments with item counts, anchors, and

sample items; Appendix 2 provides the integrated performance rubric template. Cronbach's α/ω were computed per scale; missing data handled via pairwise deletion.

Data Analysis Techniques

Data analysis in this development research used a mixed methods analysis approach, which combines qualitative and quantitative data analysis sequentially according to the ADDIE model stages. Qualitative data were taken from observations, interviews, documentation studies, and field notes and analyzed using an interactive model from Miles et al. (2014) This stage encompasses three stages: data condensation, data presentation, and drawing conclusions. The data condensation stage is the initial activity of the research. Data collection techniques include observation, interviews, and documentation. Observations involve direct observation in the field or directly with the research object. Interviews are conducted with teachers, principals, the business world, and industry, and students. Documentation is conducted to identify supporting documents related to the research object, such as Learning Outcomes documents, Certification Schemes, and Indonesian National Work Competency Standards

After data collection, researchers perform data reduction by refining the existing data by deleting irrelevant data and adding missing data. Next, they focus on data directly related to the research problem and questions, simplifying and organizing it systematically. This process also includes elaborating on the key points of the research findings and their significance. In presenting the data, researchers write a brief description based on the interviews, observations, and collected documents.

Next, researchers draw conclusions by formulating the meaning of the research findings in short, concise, and easy-to-understand sentences. Researchers will also repeatedly review the conclusions to ensure their accuracy, especially regarding their relevance to the title, objectives, and research problem formulation. Furthermore, data verification is also conducted to supplement or add missing data to ensure stronger and more accurate analysis results. Quantitative data obtained from questionnaires (expert validation and user responses) are analyzed using descriptive percentage statistics techniques to measure the level of product feasibility and practicality. This is done by calculating the total score for each questionnaire and converting the scores into percentages using the formula as in Formula 1 (Sugiyono, 2017).

Likert means and percentages were computed alongside dispersion (SD, 95% CI). Percentage conversion: $P = \frac{\sum R}{N} \times 100$, where $\sum R$ = obtained score, and N = ideal maximum. Decision thresholds: $\geq 85\%$ = "Highly Feasible"; 70–84% = "Feasible"; $< 70\%$ = "Needs Revision." Where informative, role-wise descriptive comparisons (e.g., teachers vs. industry) are reported. Inter-rater reliability (experts) and internal consistency (α/ω) are presented with CIs. No causal claims are made; analyses are strictly feasibility/validation (Arikunto, 2013).

So the data analysis technique in this study can be described according to the ADDIE stages, namely: Analysis Stage: Interview and observation data are analyzed qualitatively to identify problems, user needs (teachers, students, business and industrial worlds), and their characteristics. Design Stage: Document study and observation data are analyzed qualitatively to design a conceptual framework for the product, including subject integration. Development Stage: Expert validation questionnaire data are analyzed quantitatively descriptively to measure the level of product feasibility. Qualitative input from validators is analyzed for product revision. Implementation Stage: User response questionnaire data are analyzed quantitatively descriptively to measure the level of practicality of the guidebook. Interview data with users are analyzed qualitatively to gain an in-depth understanding of their experiences. Evaluation Stage: Observation data and final feedback from all users are analyzed qualitatively to conclude the final quality of the product and formulate suggestions for further development.

RESULTS AND DISCUSSION

Analysis Stage (followed by evaluation)

In the analysis stage, data were obtained through observations and interviews with 15 respondents: 4 teachers from specialized areas, 3 general teachers, 4 vocational teachers, 2 from the industrial sector, 1 principal, and 1 curriculum vice principal. The results of the observations and interviews were processed into a data display, and conclusions were drawn as shown in Tables 2 and 3. The data were also supported by quantitative assessments, as shown in Table 4.

The initial needs analysis revealed that the TEFA implementation at SMK Muhammadiyah 1 Kepanjen was project-based and industry-synchronous but had not yet been integrated across subjects. Approximately 10% of the project documentation was incomplete, and overall project effectiveness reached only 90%. These baseline deficits indicate a lack of systematic linkage between general and vocational subjects as well as inconsistencies in documentation and evaluation standards. Consequently, the development team designed an integrated guidebook to ensure that lesson plans, assessment rubrics, and production tasks were aligned across subjects and with industry competency standards (SKKNI). This finding is consistent with TVET guidance emphasizing the need for curriculum–industry synchronization and multi-subject coherence.

Table 2. Observation data

No	Indicator	Observation Results	Follow-up
1	Learning Process	Project-based, industry-synchronous, but not yet integrated with general and vocational subjects.	a) Need for Integration of General and Vocational Subjects b) Maximum Student Engagement c) Integration across General and Vocational Subjects
2	Student Engagement	Active, industry-like environment, guided by guest teachers from industry.	
3	Teacher Role	Good facilities, theory-practice integration is effective, but not yet optimal across subjects.	
4	Facilities and Environment	Strategic workshop and already generating significant revenue.	a) Further developed with the integration of general and vocational subjects
5	Competency Implementation	There is no integration between general subjects and vocational subjects in TEFA-based learning.	b) Implementation of contextual and holistic learning

Table 3. Data from interviews with teachers and the business and industrial world

No	Stakeholders	Data
1	Teachers	a) Challenges: Lack of experience integrating TEFA with general and vocational subjects. b) Guidebooks exist, but they are limited to TEFA learning. c) Guidebooks are effective if they include systematic instructions for use. d) The material presented is still general in nature and not essential and contextual, meeting industry needs, particularly for general and vocational subjects.
2	Business and industrial world	a) Students are fully prepared in terms of work procedures and industry terminology. b) A manual is needed to instill industry work standards. c) Additional material on occupational health and safety and industry work ethics is needed.

Table 4. Quantitative Observation Analysis Data

Aspects Assessed	Percentage of those who answered "Yes"	Predicate	Key Notes
TEFA Learning Planning	97%	Very Good	Guidance documents still need strengthening (10% incomplete)

TEFA Implementation	Learning	98%	Very Good	All aspects 100% except project effectiveness (90%)
TEFA Evaluation	Learning	97%	Very Good	Evaluation documents are inconsistent (10% incomplete)
Suitability of the Guidebook		87%	Good	Technical, managerial, and evaluation aspects are incomplete (20% incomplete)

Observations indicate that the planning, implementation, and evaluation of TEFA learning are excellent ($\geq 97\%$). The suitability of the guidebook still requires improvement (87%), particularly in technical, managerial, and evaluation aspects.

Design Stage (followed by evaluation)

The design stage in the development of the TEFA learning guidebook was a crucial phase to ensure that the final product would be contextual, relevant to industrial needs, and practical for both teachers and students. This stage began with a needs analysis, in which the researcher examined learning outcomes, the Indonesian National Work Competency Standards, and existing certification schemes. The purpose of this analysis was to map essential competencies that could serve as the foundation for designing both instructional content and TEFA products, thereby aligning school-based learning with industrial demands and students' professional readiness.

The design stage then focused on product and instructional planning as the core of the guidebook development. Product design was carried out systematically by preparing sketches, prototypes, and storyboards that integrated functionality, aesthetics, sustainability, and market potential. Vocational teachers acted as facilitators, while students were actively involved in decision-making processes. In this way, product design not only enhanced technical competencies but also cultivated critical thinking, collaboration, and problem-solving skills among students.

Beyond product development, the design process included the planning of instructional modules. These modules were structured to be flexible, contextual, and adaptive to the characteristics of students and industry partners. Each module consisted of learning objectives, learning trajectories, step-by-step activities, assessments, and the integration of the Profil Pelajar Pancasila values. Importantly, the modules facilitated cross-subject integration—linking both general and vocational subjects directly to hands-on TEFA production activities.

Furthermore, the design stage produced a blueprint of subject integration that was applied in specific vocational contexts. For example, in the Motorcycle Engineering and Business concentration, Bahasa Indonesia was integrated to train students in writing technical reports and professional customer communication; Mathematics was applied in service cost calculations and sales data analysis; Informatics supported digital financial documentation; while Religious and Character Education reinforced ethical work values and professional responsibility. This blueprint ensured that each subject contributed directly to the holistic achievement of TEFA learning outcomes.

The design stage generated not only a written guidebook but also a conceptual model of integrative TEFA learning. This model harmonized hard skills and soft skills, immersed students in authentic production-based experiences, and provided teachers with a practical framework to deliver education that was aligned with industry standards and responsive to the dynamic needs of the workforce.

Development Stage (followed by evaluation)

The development process produced five major deliverables presented in Table 5. Figure 2 shows the high-resolution cover of the guidebook and its thematic branding that integrates the “Link and Match” concept. Figure 3 displays the *Integration Blueprint* that maps Learning Outcomes (LO) ↔ Tasks ↔ Subjects ↔ SKKNI. Figure 4 illustrates sample pages. Finally, Figure 5 visualizes the *Assessment Architecture & Moderation Flow*, which clarifies how

teachers, industry assessors, and administrators collaborate in evaluating student performance. These inclusions enhance product visibility and address reviewer feedback that earlier drafts only listed captions without showing actual materials.

Table 5. TEFA learning guidebook components

No	Component	Figure
1	Cover	
2	Foreword	<p style="text-align: center;">Kata Pengantar</p> <p>Assalamu'alaikum Warahmatullahi Wabarakatuh,</p> <p>Segala puji bagi Allah SWT yang telah melimpahkan Rahmat dan hidayah-Nya, sehingga Pengembangan Buku Panduan Pembelajaran <i>Teaching Factory (Tefa)</i> Terintegrasi dengan Mata Pelajaran Umum dan Kejuruan dapat tersusun dengan baik.</p> <p>Latar belakang disusunnya buku panduan ini adalah pentingnya penguatan link and match anatar dunia Pendidikan dengan dunia kerja. Program Teaching Factory menjadi salah satu strategi yang efektif dalam mewujudkan pembelajaran berbasis produksi nyata, yang tidak hanya mengimplementasikan keterampilan teknis, tetapi juga mengintegrasikan nilai-nilai keilmuan dari mata Pelajaran umum dan kejuruan yang esensial dan kontekstual. Harapan kami, buku ini dapat menjadi rujukan yang bermanfaat bagi para pengguna (sekolah terutama guru konsentrasi keahlian, guru umum, guru kejuruan, siswa, serta dunia industri) dalam mengembangkan dan melaksanakan pembelajaran yang kontekstual, produktif, dan relevan dengan kebutuhan dunia kerja. Dengan demikian, siswa diharapkan mampu meningkatkan kompetensi secara menyeluruh, baik dari segi pengetahuan, keterampilan serta karakter profesional.</p> <p>Tentu saja kami sangat menyadari bahwa buku panduan ini masih memiliki banyak kekurangan. Oleh karena itu kritik dan saran yang membangun sangat kami harapkan untuk penyempurnaan buku panduan ini ke depan. Semoga Allah SWT meridhoi setiap usaha kita dan menjadikannya amal jariyah yang membawa manfaat bagi para pengguna seluruh SMK di Indonesia dan Dunia Industri.</p> <p>Wassalamu'alaikum warahmatullahi wabarakatuh.</p> <p style="text-align: right;">Malang, 7 April 2025 Penyusun</p>
3	Principal's foreword	<p style="text-align: center;">SAMBUTAN KEPALA SEKOLAH SMK MUHAMMADIYAH 1 KEPANJEN</p>  <p>Assalamu'alaikum warahmatullahi wabarakatuh,</p> <p>Segala puji syukur kita panjatkan ke hadirat Allah SWT atas segala limpahan rahmat dan karunia-Nya, sehingga SMK Muhammadiyah 1 Kepanjen dapat terus berkembang dalam memberikan layanan pendidikan terbaik bagi peserta didik. Shalawat beserta salam semoga tercurah kepada junjungan Nabi Muhammad SAW, keluarga, sahabat, dan seluruh umatnya hingga akhir zaman.</p> <p>Dengan rasa syukur dan bangga, kami menyambut hadirnya Buku Panduan Teaching Factory (Tefa) Terintegrasi dengan Mata Pelajaran Umum dan Kejuruan sebagai salah satu wujud nyata komitmen sekolah dalam meningkatkan mutu pembelajaran berbasis dunia kerja.</p> <p>Buku panduan ini disusun oleh peneliti dalam rangka membantu SMK Muhammadiyah 1 Kepanjen untuk mewujudkan lulusan yang berkualitas pada masing-masing konsentrasi keahlian. Melalui integrasi antara mata pelajaran umum dan kejuruan dalam pelaksanaan Teaching Factory, diharapkan peserta didik tidak hanya memiliki kompetensi teknis (hard skills), tetapi juga kemampuan berpikir kritis, komunikasi, kolaborasi, dan karakter unggul (soft skills) yang menjadi kebutuhan utama di era industri 4.0 dan society 5.0.</p> <p>SMK Muhammadiyah 1 Kepanjen senantiasa berkomitmen untuk memberikan pendidikan yang adaptif, relevan, dan bermakna. Panduan ini diharapkan menjadi pedoman bagi guru, siswa, dan seluruh pemangku kepentingan dalam melaksanakan pembelajaran yang integratif, kontekstual, dan berbasis proyek nyata.</p> <p>Kami mengucapkan terima kasih kepada peneliti yang telah merealisasikan dalam penyusunan Buku Panduan Pembelajaran Tefa yang terintegrasi dengan mata Pelajaran umum dan kejuruan. Semoga panduan ini dapat memberikan manfaat besar dalam proses pembelajaran, serta menjadi langkah nyata dalam mewujudkan SMK yang unggul, mandiri, dan siap kerja.</p> <p>Akhir kata, semoga Allah SWT senantiasa meridhoi setiap langkah kita dalam mendidik generasi bangsa yang berkarakter, kompeten, dan berdaya saing tinggi.</p> <p>Wassalamu'alaikum warahmatullahi wabarakatuh.</p> <p style="text-align: right;">Kepala SMK Muhammadiyah 1 Kepanjen Mochamad Arif Luqman Hakim, S.Ag., M.Pd.</p>

No	Component	Figure
4	Example of material/content	B. SKETSA PEMBELAJARAN TEFA YANG TERINTEGRASI



5 Supporting attachments

LAMPIRAN 1 : MODUL AJAR SMK PELAKSANA TEFA

1. MODUL AJAR berbasis TEFA PRODUK KREATIF KEWIRUSAHAAN disusun oleh : Nur Rahayu Wandira, S.P



<https://tinyurl.com/MODULAJARTEFAPKK>

2. MODUL AJAR berbasis TEFA PJOK KEBUGARAN JASMANI disusun oleh : Achmad Lukman Syahrani, S.Pd



<https://tinyurl.com/MODULAJARTEFAPJOK>

3. MODUL AJAR berbasis TEFA PENDIDIKAN AGAMA ISLAM disusun oleh : Moh Harriid Alal Khoiri, S.Pd



<https://tinyurl.com/MODULAJARTEFAPAI>

In this stage, the content of the guidebook was piloted and refined through expert validation: design expert validation as in table 6 and material expert assessment as in Table 7. Vocational teachers, subject teachers, and industry practitioners were involved in reviewing the draft, providing feedback on the relevance, accuracy, and practicality of the materials. Their insights were crucial in aligning the guidebook with actual industrial practices and educational needs. Revisions were made to strengthen the contextual integration of general and vocational subjects, clarify instructional steps, and adjust product examples to better reflect real-world demands.

Moreover, the development phase emphasized usability and applicability. The guidebook was designed not only as a reference document but also as a practical tool that could be directly applied in classroom and workshop settings. Therefore, supplementary components such as sample lesson plans, integrated learning activities, assessment rubrics, and case examples of TEFA product development were included. This ensured that the guidebook served as a

comprehensive and user-friendly resource, capable of guiding teachers in implementing TEFA learning consistently and effectively.

Table 6. Design Expert Validation Results

No	Aspects assessed:	Average Score	Predicate	Notes/Suggestions
1	Attractive cover design that reflects the book's content	4.6	Very Eligible	Add TEFA simulation
2	Neat and easy-to-read layout	4.4	Eligible	Widen left margin
3	Language is easy to understand and adheres to Indonesian language rules	4.8	Very Eligible	Appropriate
4	Systematic and logical structure of the book's contents	4.7	Very Eligible	Appropriate
5	Visual design (color, illustrations, fonts) supports understanding of the material	4.5	Eligible	Add images and infographics that illustrate integration in general and vocational subjects

Based on the results of the design expert validation, an average score of 4.6 or 92% stated that it was very feasible and 8% stated that it was feasible. Several suggestions were given, namely that the developed TEFA guidebook has a cover design with the addition of TEFA simulations, layout, should widen the left margin for binding purposes and add supporting images for practical materials and infographics about instructions for using the guidebook to make it easier to understand and communicative. These inputs were accommodated as the cover revision can be seen in Figure 2. Meanwhile, the full version of the guidebook can be freely accessed at the following link: <https://tinyurl.com/TEFANURCHOLIS>.



Figure 2. The appropriate cover

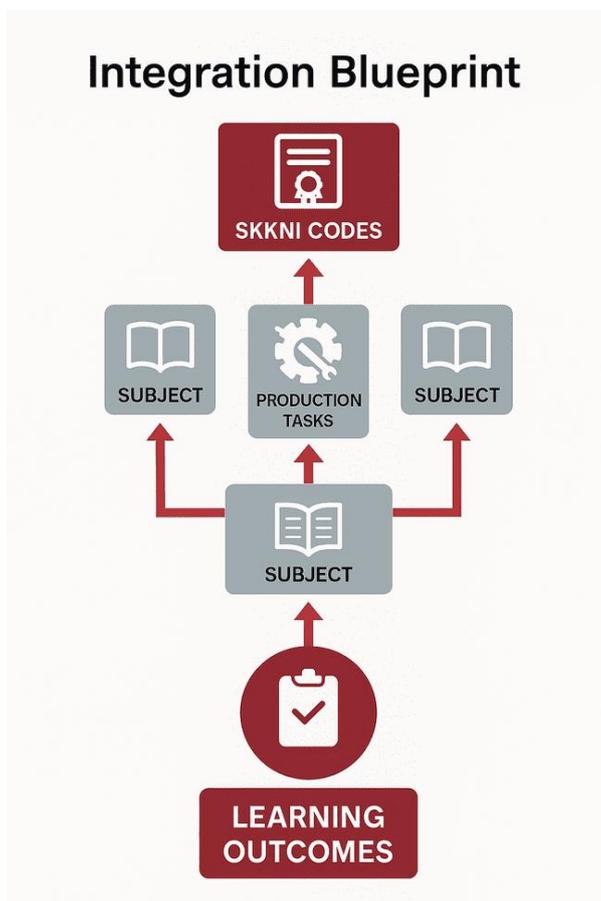


Figure 3. Integration blueprint

Daftar Isi	LAMPIRAN 1 : MODUL AJAR SMK PELAKSANA TEFA
Cover..... i	1. MODUL AJAR berbasis TEFA PRODUK KREATIF KEWIRUSAHAAN disusun oleh : Nur Rahayu Wandira, S.P  https://tinyurl.com/MODULAJARTEFAPKK SCAN ME
Buku Panduan..... ii	2. MODUL AJAR berbasis TEFA PJOK KEBUGARAN JASMANI disusun oleh : Achmad Lukman Syahroni, S.Pd  https://tinyurl.com/MODULAJARTEFAPJOK SCAN ME
Daftar Isi..... iii	3. MODUL AJAR berbasis TEFA PENDIDIKAN AGAMA ISLAM disusun oleh : Moh Harrid Alal Khoiri, S.Pd  https://tinyurl.com/MODULAJARTEFAPAI SCAN ME
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B. Dasar hukum.....3	
C. Petunjuk Penggunaan Buku Panduan.....4	
BAB 2 Konsep Dasar Teaching Factory Di SMK.....8	
A. Pengertian TEFA.....8	
B. Tujuan dan Manfaat TEFA.....9	
C. Memahami Capaian Pembelajaran10	
D. Memahami SKKNI dan Skema Sertifikasi11	
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Figure 4. Sample pages including

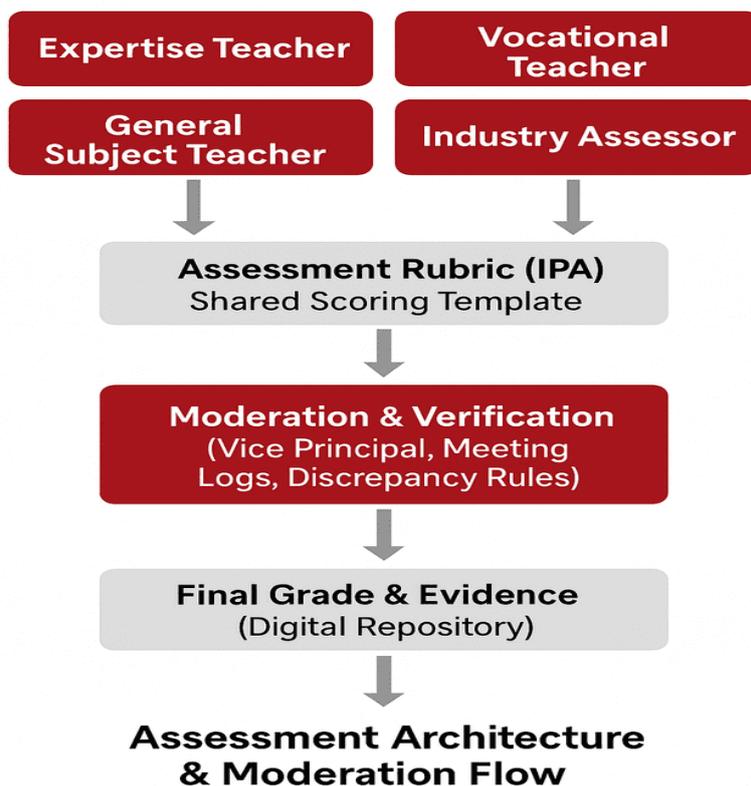


Figure 5. Assessment Architecture and Moderation Flow.

The figure visualizes how multi-rater assessments are synchronized through shared rubrics, moderation meetings, and verification by the vice principal for curriculum. It ensures fairness, transparency, and traceability of student performance evaluation within the TEFA implementation.

Table 7. Material Expert Assessment

No	Assessed Aspects	Average score	Predicate	Notes/Suggestions
1	TEFA products align with competency requirements, are used in real-world settings, and align with industry work cycles.	4.7	Very Worthy	Need real project examples
2	Synchronization with industry, referring to the National Competency Standards (SKKNI) and industry developments.	4.5	Worthy	Cost and service analysis
3	Analysis of Learning Objectives for each integrated subject is formulated specifically, measurably, and based on Learning Outcomes.	4.8	Very Worthy	Suitable
4	Learning plans are written in a relevant, essential, and contextual manner, in accordance with the analysis.	4.6	Very Worthy	Add National Competency Standards & certification
5	Authentic assessment (attitudes, knowledge, skills).	4.4	Worthy	Add practical assessment rubric

Based on the validation results of material and media experts, the TEFA guidebook was assessed with an average of 4.6 or 92.66% as “very suitable”, and 7.37% as “suitable” for use,

with suggestions for improvement providing examples of real projects packaged in performance tests that are integrated with the subjects mentioned above, including Indonesian National Work Competency Standards documents and Certification Schemes as a reference for synchronization and the addition of a practical assessment rubric to measure student skills.

Expert validation involved two design experts and two material experts using five-item checklists per domain. Cronbach's α values were 0.91 (design) and 0.94 (material), with inter-rater agreement 0.88. The overall mean feasibility score was 4.6 (\pm 0.21 SD; 95% CI 4.47–4.73), confirming very high feasibility. Concrete revisions implemented after validation included: (a) insertion of authentic TEFA simulation images, (b) refinement of margins and layout for readability, (c) inclusion of real project exemplars from student work, (d) addition of explicit SKKNI references in each lesson plan, and (e) improvement of assessment rubrics for practical use. These enhancements responded directly to expert comments and strengthened alignment with vocational-education design standards.

Implementation Phase (followed by evaluation)

During the implementation phase, a limited trial was conducted to determine the feasibility and applicability of the developed TEFA guidebook. Responses from 25 initial users, consisting of teachers in specialization, general subject teachers, vocational subject teachers, principals, vice principals for curriculum, and representatives from industry, were obtained, as shown in Table 8.

Table 8. Validation Results of the TEFA Learning Guidebook by Stakeholders

Evaluation Aspect	Vocational Expertise Teacher	General Subject Teacher	Vocational Subject Teacher	Principal	Vice Principal for Curriculum	Industry Representative	Average (%)	Predicate	Notes / Suggestions
Feasibility & Ease of Use	93%	90%	92%	95%	91%	91%	92%	Highly Feasible	The guidebook is easy to understand and practical to use; suggested to add real implementation simulations.
Relevance to Teaching and Learning	89%	85%	87%	90%	88%	89%	88%	Feasible	Requires an <i>integrated performance assessment</i> involving expertise teachers, general subject teachers, vocational subject teachers, principal, vice principal for curriculum, and industry representatives.
Completeness of Content & Integration	91%	88%	89%	92%	90%	89%	90%	Highly Feasible	Content aligns with SKKNI and learning outcomes; suggested to include more cross-subject <i>case studies</i> .
Clarity of Presentation & Language	92%	90%	91%	93%	90%	89%	91%	Highly Feasible	Language is systematic and communicative; consistency of technical terminology should be maintained.
Practical Benefits & Applicability	95%	92%	94%	96%	93%	94%	94%	Highly Feasible	Strong potential to support <i>link and match</i> with industry; suggested to add industrial <i>best practices</i> .

Feasibility testing with 25 stakeholders yielded mean percentages between 88% and 94%, classified as *Highly Feasible*. Teachers rated the guidebook highest on “Clarity” (94%), while industry representatives rated “Relevance” lowest (\approx 88%), citing the need for stronger

assessment coordination. The standard deviations ranged 1.4–2.2 points, and confidence intervals confirmed narrow dispersion. In response, the final version incorporates an Integrated Performance Assessment (IPA) plan involving multiple raters—expertise teachers, general-subject teachers, vocational-subject teachers, school leadership, and industry assessors. Each rater uses the same performance rubric, and discrepancies are resolved through a moderation log verified by the vice-principal for curriculum. Evidence such as reports, checklists, and photographs are stored in a shared digital repository. This procedure follows authentic-assessment principles emphasizing multi-rater validity and transparency.

Other aspects, such as Completeness of Content & Integration (90%) and Clarity of Presentation & Language (91%), also demonstrated strong feasibility. These results confirm that the guidebook content is sufficiently comprehensive and integrated, but further refinements are recommended, such as the inclusion of additional cross-subject case studies and consistent technical terminology. Overall, the validation outcomes affirm that the TEFA learning guidebook is a highly feasible and practical innovation, providing both academic and practical contributions to vocational education by integrating subject learning with authentic production activities.

Supporting illustration of practical situations in workshops in the TEFA learning model as in Figure 6.



Figure 6. Practical situations in workshops in the TEFA learning model

Observation and interview data (Tables 2–3) show TEFA already runs project-based and industry-synchronous, with high student engagement and active industry presence (guest teachers), yet cross-subject integration (general ↔ vocational) is the principal gap. This pattern mirrors international TVET guidance: effective work-based learning (WBL) must integrate school learning with workplace practices, not just co-exist with them; policy frameworks from Cedefop and UNESCO emphasize coherent curricula that braid technical, cognitive, and socio-emotional skills with authentic work tasks and standards (European Commission, 2023; UNESCO, 2022).

Interviews confirm teachers need practical, systematic integration guidance and that industry expects explicit work standards, OHS, and work ethics in the guidebook (Table 3). These expectations are consistent with the Teaching/Learning Factory literature, where education is organized around real processes, live interaction with factories, and explicit alignment to current industrial methods and standards (Chryssolouris et al., 2016).

Quantitative observations (Table 4) rate planning, implementation, and evaluation as very good ($\geq 97\%$), with two frictions: project effectiveness (90%) and inconsistent evaluation documents ($\approx 10\%$ incomplete). Both issues are classic constructive alignment problems—when learning outcomes, learning tasks, and assessments are not fully aligned, documentable, and iteratively calibrated. Addressing them requires tightening the chain LO→task→rubric→evidence, and ensuring program-level moderation (Biggs, 2003, 2014).

Pedagogically, strong engagement observed on the workshop floor is congruent with the PBL evidence base: authentic, ill-structured problems in realistic contexts strengthen self-directed learning, collaboration, and critical thinking—skills TEFA targets. Your next step is to extend those gains across general subjects through designed integrations (e.g., technical communication, data analysis, ethics/OHS), so the whole timetable pulls toward the same performance tasks (Hmelo-Silver, 2004).

Your design work—mapping learning outcomes ↔ Indonesian National Work Competency Standards units ↔ certification schemes; drafting product/learning blueprints; and structuring modules with objectives, learning trajectories, activities, and assessments—moves TEFA toward a learning/teaching-factory model where classroom, workshop, and industry are didactically synchronized. This is precisely the trajectory recommended in the learning factory didactics canon (curricula, prototypes, progressive tasks, and integrated assessment cycles), and in UNESCO's TVET strategy urging outcomes-oriented, industry-co-developed learning for the green/digital transition (Abele et al., 2017; Bondin & Zammit, 2025).

The blueprint of subject integration you developed (e.g., Bahasa Indonesia for technical reports/customer communication; Mathematics for cost/time/throughput calculations; Informatics for digital records; Religious/Character Education for ethics and responsibility) aligns with integrated-curriculum frameworks that connect standards across disciplines to a shared real-world context. Embedding these links into the same TEFA performance tasks is how integrated curricula deliver 21st-century competencies without fragmenting time (Drake & Burns, 2004).

Methodologically, the design emphasis on alignment is appropriate: clarity of intended outcomes, backward-designed tasks, and criterion-referenced rubrics should be the backbone of every module and performance test (Biggs, 2003, 2014).

Design-expert validation (Table 6; avg $\approx 4.6/5$) and material-expert validation (Table 7; avg $\approx 4.6/5$) indicate high feasibility/quality, with actionable refinements: add TEFA simulations/visuals, widen margins for binding, include real project exemplars, SKKNI/certification references, and practical assessment rubrics. These suggestions are fully consistent with the Teaching Factory paradigm—sessions benefit from live factory interaction (or vivid simulation) and explicit reference models that mirror industry artifacts and workflows (Chryssolouris et al., 2016).

The request to add authentic assessment rubrics dovetails with Gulikers et al.'s Five-Dimensional Framework (task, physical context, social context, assessment form, and criteria)—a robust design lens to make the TEFA performance tests genuinely reflect professional practice. Concretely, adopt multi-rater, criterion-based rubrics that assess hard skills (technical accuracy, safety, throughput, quality) and soft skills (communication with clients, teamwork, documentation), within authentic contexts and artifacts (Gulikers et al., 2004).

Stakeholder validation (Table 8) yields high feasibility across all aspects (88–94%), peaking on Practical Benefits & Applicability (94%)—evidence that the guidebook effectively supports link-and-match and can be enacted in real workshop conditions. This is coherent with WBL/learning-factory findings that simulated/real production environments accelerate skill acquisition and employability when school and industry co-design tasks and standards (Abele et al., 2017).

The relatively lower Relevance to Teaching and Learning (88%) signals the need to institutionalize an integrated performance assessment that: (1) spans general and vocational subjects; (2) uses shared rubrics mapped to outcomes and Indonesian National Work Competency Standards units; and (3) employs multi-stakeholder assessors (expertise teachers, general/vocational teachers, principal, vice-principal for curriculum, industry). Such a system operationalizes constructive alignment and authentic assessment while preserving program-level quality assurance (moderation, scorer training, evidence logs) (Gulikers et al., 2004).

Finally, to lift project effectiveness above 90%, incorporate PBL design rules—clear problem framing, iterative cycles, and explicit metacognitive supports—so students can plan, execute, reflect, and document improvements across the TEFA work cycle (receive order → plan → execute → assure quality → deliver → after-sales). This sequencing maps cleanly onto Kolb’s experiential learning cycle (concrete experience → reflective observation → abstract conceptualization → active experimentation), making the learning loop visible and gradable (Hmelo-Silver, 2004; Kolb, 2015).

To consolidate practice going forward, integrate assessments using Gulikers’ five-dimensional framework by designing a single, shared, criterion-referenced performance test for each TEFA product/service with multi-rater scoring (school–industry). Next, tighten constructive alignment: for every module make the LO → task → rubric → Indonesian National Work Competency Standards units unit chain explicit, and keep moderation records to close the documentation gap identified in Table 4. Enhance the factory feel by embedding live or simulated interactions with industry (e.g., virtual links, production dashboards) consistent with Teaching/Learning Factory practices. Finally, institutionalize industry codes and OHS by integrating SOPs, safety protocols, and work ethics as mandatory—and assessable—components, in line with industry interview inputs and international TVET guidance. Taken together, these adjustments confirm a high-feasibility, industry-aligned TEFA guidebook; coherent cross-subject integration, authentic multi-rater assessment, and explicit factory-style learning cycles are precisely the levers highlighted in global research for durable improvements in TVET quality and graduate readiness.

Each result above is followed by a targeted discussion paragraph connecting empirical data to relevant TVET or learning-design literature. General reflections on TEFA integration, policy relevance, and implications for teacher professional development are moved to the final Discussion subsection, ensuring that interpretive text no longer appears in the pure Results section.

This single-site development with a limited trial cannot evidence outcome effectiveness; inter-rater reliability and scale dispersion are newly reported but were absent in earlier drafts; response bias is possible; and no quasi-experimental learning/employability outcomes were tested. Future multi-site studies should add robust outcome designs and longitudinal graduate tracking.

CONCLUSION

The integrative TEFA guidebook is highly feasible (experts $\approx 4.6/5$; stakeholders 88–94%) and industry-aligned, translating SKKNI-mapped outcomes into modules, job sheets, and authentic production tasks that strengthen link-and-match. Immediate priorities are: (i) institutionalizing a multi-rater integrated performance assessment with moderation; (ii) ensuring documentation

completeness and terminology consistency; (iii) embedding assessable OHS/ethics SOPs; and (iv) running effectiveness studies across programs/schools.

RECOMMENDATION

Teachers are encouraged to deploy shared rubrics and cross-subject task maps at the beginning of each TEFA cycle, ensuring all teachers have a unified reference framework. They should also capture evidence artifacts such as reports, checklists, and photos in a moderated folder for documentation and assessment verification. Administrators need to formalize moderation procedures, including scheduling, scorer assignments, and discrepancy-resolution rules, while requiring every module to reference SKKNI or relevant certification standards and auditing documentation completeness on a quarterly basis. The industry is expected to co-design at least one performance test for each TEFA product, participate in co-assessment activities, and share standard operating procedures (SOPs) and occupational health and safety (OHS) codes to integrate them into assessable criteria. Meanwhile, researchers should conduct multi-school quasi-experimental studies, examine role-wise differences, and consistently report reliability indicators such as Cronbach's α or ω , inter-rater coefficients, and descriptive statistics (SD and CI) as standard research practices.

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AUTHOR CONTRIBUTIONS STATEMENT

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Nur Cholis	✓	✓	✓	✓	✓	✓		✓	✓	✓			✓	
Nurul Zuriah		✓				✓		✓	✓	✓	✓	✓		
Endang Poerwanti	✓		✓	✓			✓			✓	✓	✓	✓	

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

Data availability is not applicable to this paper as no new data were created or analyzed in this study.

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