Jurnal Pendidikan Progresif
e-ISSN: 2550-1313 | p-ISSN: 2087-9849
URL: https://jpp.fkip.unila.ac.id/index.php/jpp
Jounal's DOI: http://doi.org/10.23960/jpp

Vol. 16, No. 2, 2026
Article ID: 1769
Pages: 1341-1370

The Role of Teaching Factory in Forming Vocational Students' Work Readiness: A Literature Review

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Received: 05 May 2026 *Accepted: 27 June 2026* *Published: 07 July 2026*

Abstract: Teaching Factory (TeFa), which integrates an industrial work environment into schools, has been widely implemented in vocational education to bridge the gap between schools and industry. Previous studies have reported TeFa's ability to enhance students' work readiness by developing soft skills. The purpose is to synthesize the extent of TeFa implementation and examine its contribution to the development of soft skills that support vocational students' work readiness. This study used a systematic literature review of 35 articles published between 2022 and 2026. A thematic and comparative synthesis of data was conducted using articles selected based on compliance with inclusion and exclusion criteria. The articles were retrieved from databases and analyzed to identify codes and themes related to TeFa and its impact on students' work readiness. Literature review revealed a positive relationship between the implementation of TeFa and vocational students' work readiness. The findings identified 12 soft skills associated with TeFa implementation, including adaptability, communication, teamwork, problem-solving, critical thinking, leadership, flexibility, creativity, initiative, responsibility, entrepreneurship, and innovation. The most frequently reported skills in this literature were adaptability (22%), communication (19%), and teamwork (15%). The findings suggest that these soft skills can be organized into three competency clusters: adaptive, collaborative, and value-creation. Despite the positive impact, challenges remain, including limited industrial partnerships, inadequate facilities, budget constraints, and variations in educator competency. TeFa has been an effective approach for strengthening vocational students' work readiness by fostering soft skills through authentic learning. Therefore, future research should focus on developing comprehensive implementation and evaluation frameworks to support more systematic, effective, and sustainable implementation of TeFa.

Keywords: teaching factory, evaluation, soft skills, work readiness.

Article's DOI: https://doi.org/10.23960/jpp.v16i2.pp1341-1370

INTRODUCTION

The origins of the Teaching Factory concept can be traced to educational initiatives that involved numerous lecturers at Washington University and Puerto Rico-Mayagüez University (Yondri et al., 2020; Pratama et al., 2025). Since its origins, TeFa has evolved into an industry-based learning approach that integrates industrial practices, work procedures, and production-oriented activities within vocational education settings. In this concept, laboratories are not merely instructional spaces; they function as units of production or as businesses that mirror those found in actual workplaces (Casmudi et al., 2022; Wahjusaputri et al., 2024). Such exposure allows learners to experience work processes in a more realistic context while strengthening their practical capabilities.

Beyond acquiring technical skills, TeFa plays a strategic role in enhancing graduate readiness for professional employment. TeFa is a learning strategy aimed at producing professional

graduates in their fields, developing modern curricula, finding solutions to meet industry demands, and adapting to technological developments (Wahjusaputri & Bunyamin, 2022). By aligning learning activities with industry standards, TeFa supports the development of relevant competencies and increases closer collaboration between vocational education institutions and industry partners. Another important dimension lies in the integration of information and communication technologies (ICTs). Tefa uses ICTs to connect the classroom and industry, enabling two-way knowledge exchange (Mourtzis et al., 2022). The TeFa policy implementation in Indonesia is based on Presidential Instruction No. 9 of 2016, which concerns the revitalization of vocational high schools. This Presidential Instruction mandates that the Minister of State-Owned Enterprises, the Minister of Finance, and the Minister of Industry support the development of TeFa by evolving labor market requirements and workforce development priorities (Presiden Republik Indonesia, 2016).

The increasing complexity of today's workplace has led to a shift in industrial expectations, away from a primary focus on technical competencies. Recent studies have shown that employability is associated with a combination of transferable competencies that enable individuals to navigate uncertain labor market conditions (Kholifah et al., 2025; Xue & Ooi, 2026). In the context of the evolution of Industry 4.0 and 5.0, vocational education graduates are expected to be able to not only perform technical skills but also demonstrate the ability to respond to technological changes, work collaboratively, and continuously develop their career competencies (Magagula & Awodiji, 2024; Suyatmo et al., 2025). Due to these graduate competency demands, vocational education institutions are increasingly challenged to provide an authentic learning environment. This environment enables students to integrate technical expertise with specific work competencies that reflect workplace needs in specific areas. This is what differentiates vocational education from general education.

Every field of expertise requires mastery of specific competencies for those currently working in or planning to work in that field. The most important competencies to master are acquired through hands-on practice in a dynamic work environment that reflects the industry, enabling students to become more skilled and better able to respond to unexpected real-world situations (Rosidah & Sutirman, 2023; Vargas et al., 2023). Several studies emphasize the importance of balancing technical competencies with soft skills among vocational students (Jaedun et al., 2024). Vocational education will be effective if students are taught the materials, tools, and tasks that are operationally similar to those they will use in the workplace (Murwaningsih et al., 2026; Yunus et al., 2023). TeFa is here to bridge industry and education, improving students' employability by providing practical skills training, including hands-on work with real-world tools and scenarios that reflect industry standards (Febyola et al., 2025; Isnandar et al., 2023).

TeFa implementation is carried out by aligning the school curriculum with industry, with industry playing a 70% role in determining the curriculum, ensuring that learning in vocational schools remains relevant to industry (Wahjusaputri & Bunyamin, 2022). Vocational schools will build partnerships with related industries willing to distribute products made by their students. As a case in point, the catering firms Nikmat and Diva are collaborating with students at State Vocational School 4 (Casmudi et al., 2022). TeFa has demonstrated its impact on enhancing students' technical and soft skills, including communication, collaboration (teamwork), and interpersonal skills (Imran et al., 2024; Wahjusaputri, Nastiti, & Liu, 2024). So,

vocational students must have competencies closely aligned with industry and labor market needs as an important qualification to ensure graduates possess relevant skills (Yati et al., 2026).

Several vocational theories proposed by Charles Prosser illustrate the ideal conditions of TeFa. The first theory states that vocational education will be effective if students are taught using materials, tools, machines, and tasks that are identical to, or simulated in, the industry where they will work. Furthermore, the second theory confirms that vocational training is effective when the assigned tasks have operational similarities to the equipment and machines they will use in their future work (Yunus et al., 2023). So ideally, TeFa can bridge the gap between students' competencies obtained in schools and industry's needs by bringing an industrial atmosphere into schools (Casmudi et al., 2022; Wahjusaputri & Bunyamin, 2022).

Recent studies support the relevance of Prosser's ideas in contemporary vocational education. The literature indicates that students' experience will be more meaningful and may increase work readiness if the practical environment in which they practice is more closely aligned with industry (authentic). Therefore, several studies are recommended to optimize graduates' job readiness (Alifiana et al., 2026; Nuraeni, 2025; Yoto et al., 2024). These findings suggest that Prosser's theorem remains relevant in this era, although the conditions of application in vocational education have changed considerably. In this context, the effectiveness of TeFa increasingly depends on valuable industry engagement, up-to-date learning facilities, and practice implementation that is authentically similar to real workplace environments.

However, in practice, the implementation of TeFa still faces various obstacles, including suboptimal school management, limited human resource competence, and inadequate infrastructure (Susilowati et al., 2024; Wijanarka et al., 2023). Many schools struggle to manage TeFa and to integrate them into the industry, so that the promotion of products/services is limited to certain groups (Purba et al., 2024; Setiawan & Warta, 2026). In addition, important external factors that remain obstacles to the implementation of TeFa are weakly established industrial partnerships and the industry's lower trust in schools, thereby hindering the creation of sustainable collaboration (Setiadi et al., 2025; Suroto et al., 2024).

The problem with the implementation of TeFa is supported by the latest BPS unemployment rate data, which show that vocational school graduates remain in the highest category at 8.63% (Badan Pusat Statistik, 2026). The facts presented contradict the reality of vocational school graduates, who should be best prepared for work. This phenomenon is due to inconsistencies and a lack of in-depth evaluation of the development of work character (soft skills) among students (Sembiring et al., 2026; Wuryanto et al., 2026).

Issues that arise during implementation need to be addressed to prevent lasting negative impacts, especially on students. Strengthening soft skills within the TeFa curriculum is essential to prepare students to be more adaptable and ready for work upon graduation. TeFa is crucial because it connects vocational high school learning with the industrial world. This paper aims to evaluate TeFa's role in improving students' job readiness. Therefore, the research question is: How can the implementation of TeFa impact the soft-skills competency of vocational high school graduates? This study is expected to provide practical recommendations for schools to optimize the implementation of TeFa.

METHOD

Research Design

This research is qualitative and uses a literature review approach. A literature review is a study of all related research on a particular

topic, theme, or academic field to identify gaps and set an agenda for future research (Chigbu et al., 2023; Paul, 2025). The literature review in this study aims to synthesize the extent of the implementation of the Teaching Factory (TeFa) program and identify shortcomings that need to be addressed to maximize graduate work readiness. This study focuses on how the Teaching Factory is being implemented, improvements in work readiness, the soft skills gap among vocational high school graduates, and the alignment between school curricula and industrial competencies.

Search Strategy

Our analysis process was based on an examination of reviews in well-regarded journals. The literature database was collected from Google Scholar and ScienceDirect. Google Scholar was selected because of its broad coverage of scholarly publications across disciplines. At the same time, ScienceDirect was used to complement the search by providing access to peer-reviewed international journal articles. The literature was selected based on the suitability of the title, abstract, and full document containing the specified search terms. The identification stage began with keyword-based searches related to the main concepts of this study, including "Teaching Factory", "TeFa", "Factory-Based Learning", "Soft Skills", "Work Readiness", and "Employability". These keywords were used to retrieve potentially relevant studies from the selected databases. The search strategy was further refined using Boolean operators (OR) and (AND) (Nurtanto et al., 2021). To improve transparency and reproducibility, these keywords were subsequently structured into the following Boolean search string:

("Teaching Factory" OR "TeFa" OR "Factory-Based Learning") AND ("Teaching Factory Evaluation" OR "Teaching Factory Implementation") AND ("Soft Skills" OR "Work Readiness" OR "Employability").

The search string was applied in Google Scholar and ScienceDirect, with minor adjustments to accommodate the search functions and syntax requirements of each database. To strengthen the searching process, backward and forward citation tracking were performed on key studies identified during the initial screening phase. Backward citation tracking involved examining the reference lists of highly relevant articles, while forward citation tracking used Google Scholar's Cited by feature to identify more recent studies referencing those articles.

This procedure was performed to avoid potentially missing relevant literature due to differences in terminology, indexing practices, or database coverage. Given that research related to Teaching Factory is often published under other terms such as factory-based learning, learning factory, and industry-based learning. This citation tracking provided an additional opportunity to capture potentially relevant literature beyond the keyword-based search. Although some literature was identified through this process, only those that met the inclusion criteria were retained for further review.

The study focuses on implementing the teaching factory, improving work readiness, addressing the soft-skills gap among vocational high school graduates, and aligning the school curriculum with industry competencies. Inclusion criteria were established to filter and select articles that were most relevant to the research objectives. At the same time, exclusion criteria were used to exclude studies that did not meet the requirements. The preliminary reduction of records was conducted using database filters for publication year, language, document type, and relevance to the search topic. The remaining studies were then manually screened against title, abstract, and full-text eligibility criteria. This publication period was restricted to 2022-2026

to ensure that the findings reflected the current state of Teaching Factory (TeFa) practices in vocational education. This period reflects that vocational education has been transformed by rapid digitalization, the adoption of technologies from Industry 4.0 to Industry 5.0, and stronger expectations from industry and the job market for vocational graduates to have stronger technical competencies and soft skills. By focusing on a review of literature published over the last five years, it is possible to synthesize real-world evidence relevant to current practice implementation, including emerging constraints and current labor market demands.

These criteria were established to ensure that the selected literature was directly relevant to the objectives of this study, especially in examining the implementation of TeFa and the contributions to vocational students' work readiness and soft skills development. The inclusion and exclusion criteria used in this review are shown in Table 1 below.

Table 1. Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
Publications written in English	Publication written in a language other than English
Articles published between 2022 and 2026	Articles published before 2022
Scopus-indexed international journals	Non-Scopus-indexed international journals
Implementation of Teaching Factories within vocational education	Implementation of Teaching Factories outside of vocational education
Articles analyzing the implementation of Teaching Factory and its impact on work readiness and soft skills development	Articles that analyze only physical production output or purely technical skills in Teaching Factory implementation, without measuring the impact on work readiness and soft skills development.

Although Google Scholar and ScienceDirect served as the initial source for identifying relevant literature, an additional screening process was conducted to ensure the quality of the selected literature. Once literature was identified as relevant to the research, journals' indexing status was checked using the SCImago Journal & Country Rank (SJR) database, which is based on Scopus data. Only literature published in journals listed in the SJR database was included in the review, and literature from journals that could not be verified as Scopus-indexed was excluded. This procedure was implemented to maintain the methodological rigor of the review while ensuring comprehensive coverage of the literature.

Based on the inclusion and exclusion criteria defined in Table 1, the literature selection process used is shown in the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram. This systematic approach illustrates the transformation from the initial identification of records to the final synthesized library, as shown in Figure 1 below.

Quality Appraisal

To avoid the risk of bias in this literature review, a quality assessment was conducted using the standard Mixed Methods Appraisal Tool (MMAT). MMAT does not calculate an overall numerical score but rather assesses methodological quality (Hong et al., 2018). The assessment is based on the extent to which each piece of literature used meets the criteria appropriate to its research design.

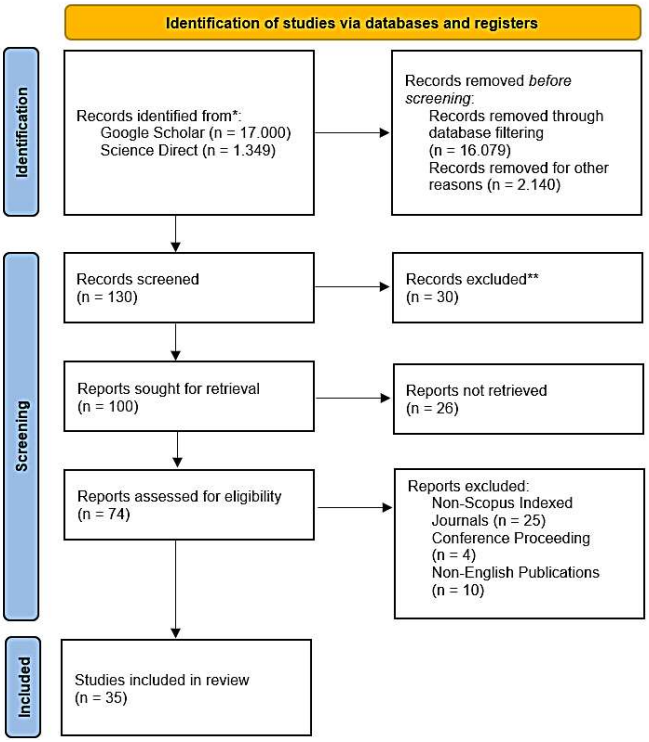

Figure 1. PRISMA flow diagram

Based on the MMAT classification, 27 of the 35 reviewed studies were categorized as empirical studies eligible for MMAT quality assessment. This literature comprised qualitative studies (n = 6), quantitative descriptive studies (n = 11), non-randomized quantitative studies (n = 5), and mixed methods studies (n = 5). The distribution of study types is shown in Table 2. Eight studies were not subject to MMAT assessment because they were systematic literature reviews, bibliometric analyses, and conceptual papers, which fall outside the scope of the MMAT. Nevertheless, these studies were retained in the review because they provided

Table 2. Distribution of included studies according to MMAT categories

Research Design	N	Articles
Qualitative	6	(Jaedun et al., 2024; Jing et al., 2023; Mourtzis et al., 2022; Ramdhani et al., 2025; Rosidah & Sutirman, 2023; Thianthai & Sutamchai, 2022)
Quantitative Descriptive	11	(Cai et al., 2023; Chinedu et al., 2023; Daryono et al., 2023; Davila Laguna et al., 2025; Fang et al., 2024; Isnandar et al., 2023; Löfgren et al., 2023; Marcionetti et al., 2025; Su et al., 2023; Sutiadiningsih & Mahfud, 2023; Wu et al., 2023)
Quantitative Non-Randomized	5	(Hulyadi et al., 2025; Kozlovsky et al., 2022; Maksum et al., 2022; Tian & He, 2024; Wahjusaputri & Bunyamin, 2022)
Mixed Methods	5	(Twyford & Dean, 2024; Vargas et al., 2023; Wahjusaputri et al., 2024; Wuryanto et al., 2026; Yoto et al., 2024)
Not Applicable	8	(De Vos et al., 2024; Dubiel et al., 2025; Espina-Romero et al., 2023; Indriatno Putra Pratama et al., 2025; Jamaludin et al., 2023; Mohammed & Ozdamli, 2024; Pacher et al., 2023; Tikhonova & Raitskaya, 2023)
Total	35	

valuable theoretical and contextual insights into the implementation of factory-based teaching, employability skills, work readiness, competency development in vocational education.

The assessment process demonstrated that most empirical studies met methodological criteria relevant to their respective research designs, particularly in terms of clearly stated research objectives, appropriate research design, adequate data collection procedures, and consistency between data analysis and interpretation. Therefore, all empirical studies were deemed methodologically acceptable and retained for the final synthesis.

Data Analysis

The data were analyzed using thematic synthesis, a qualitative method for summarizing and integrating findings from the literature reviewed. During the thematic synthesis process, codes were created inductively as new ideas were identified (Lauzon-Schnittka et al., 2022). The selected articles were analyzed using thematic analysis adapted from Braun and Clarke's framework (Clarke & Braun, 2017). The thematic synthesis technique begins by identifying all included studies related to TeFa implementation and vocational students' work readiness.

Relevant statements and findings were initially coded to represent specific soft skills and employability attributes and then grouped into broader themes using NVivo software. Open coding was conducted across the selected literature to identify concepts related to TeFa implementation, soft skills, and work readiness. Similar codes were grouped into categories through axial coding and subsequently synthesized into themes. The coding process in Table 3 demonstrates the progression from open codes to categories and themes through NVivo thematic synthesis. A total of 101 codes were generated and subsequently organized into categories and themes.

The themes identified in this study were 12 soft skills related to TeFa implementation, including adaptability, communication, teamwork,

Table 3. Illustration of NVivo theme development process

Theme	Categories	Open Codes
Soft Skills	Adaptability	Openness to Learn, Resilience, Respond to Change, Environmental Adaptation, Know to Act
	Communication	Active Participation, Public Speaking, Building Relationships, Coordinate
	Teamwork	Construct Ideas, Achieving Shared Goals, Role Coordination, Supporting Team
	Problem Solving	Handle Conflict, Generate Solutions, Problem Identification
	Critical Thinking	Anticipating Failure, Objective Judgment, Critical Mindset
	Leadership	Self-Control, Confidence, Decision Making, Managing Team Members
	Flexibility	Adjustment Action
	Creativity	Generating Idea, Creating Creation
	Initiative	Seeking Information, Willingness to Learn, Proactive Action
	Responsibility	Caring Work Environment, Honesty, Discipline, Commitment
	Entrepreneurship	Entrepreneurial Mindset, Business Awareness
	Innovation	Innovative Thinking

Teaching Factory	Authentic Learning	Experiential Learning, Project-Based Learning, Authentic Environment
	School-Industry Partnership	Industry Role, School Role, Curriculum Development, Knowledge Transfer
Work Readiness	Competency Development	Technical Readiness
	Employability Skills	Career Success, Integration of Soft Skills and Hard Skills

problem-solving, critical thinking, leadership, flexibility, creativity, initiative, responsibility, entrepreneurship, and innovation. These themes were then reviewed and refined through cross-study comparisons to ensure conceptual consistency. In the end, the themes were synthesized into broader competency groups to develop a conceptual framework explaining how TeFa contributes to vocational students' work readiness. Next, it maps the positive and negative impacts that arise and formulates alternative solutions to these negative impacts.

The results were continuously analyzed using a comparative synthesis technique that focused on contrasting findings, methods, or theories across various research sources. The comparative synthesis was conducted to examine the implementation of TeFa across various schools, as reviewed in the literature. The synthesis results determined the impact of TeFa implementation on graduates' work.

RESULT AND DISCUSSION

The literature review examined 35 articles published from 2022 to 2026. The articles were selected based on the inclusion criteria outlined in Table 1. The research articles were distributed by year in Figure 2 with the following details: 2022 (14.3%; n=5), 2023 (40%; n=14), 2024 (25.7%; n=9), 2025 (17.1%; n=6), and 2026 (2.9%; n=1). Figure 2 shows the distribution of publication years in the literature. Overall, the selected articles focused on the implementation of Teaching Factory (TeFa) and the development of soft skills in the context of vocational education.

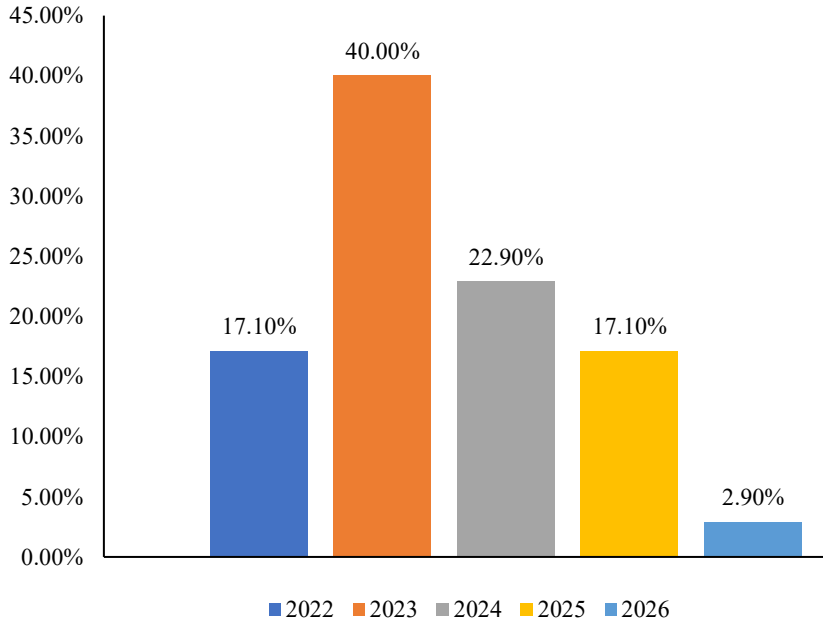

Figure 2. Distribution of article by year published

The articles found were published in international journals indexed in Scopus, with Q1-Q4 impact factors. The research used was predominantly from Sustainability and the International Journal of Evaluation and Research in Education (IJERE), amounting to 8.57%. The distribution is presented in Table 4 below.

Table 4. Distribution of articles with journal identification

Journal Rank	Journal Name (Publisher)	SJR Score (2025)	Frequency	Percentage (%)
Scopus Q1	Sustainability	0.750	3	8.57
	Social Science & Humanities Open	0.634	2	5.71
	International Journal of Computer Integrated Manufacturing	0.884	1	2.85
	Multimedia Tools and Applications	0.798	1	2.85
	Sustainable Futures	1.097	1	2.85
	Interactive Learning Environments	2.240	1	2.85
	Ain Shams Engineering Journal	1.028	1	2.85
	Journal of Language and Education	0.412	1	2.85
	Behavioral Sciences	0.828	1	2.85
	Heliyon	0.739	1	2.85
	Accounting Education	0.879	1	2.85
	Journal of Career Development	1.277	1	2.85
	Journal of Occupational and Organizational Psychology	2.156	1	2.85
	Frontiers in Psychology	0.941	2	5.71
	Cogent Education	0.722	1	2.85
	International Journal of Adolescence and Youth	0.806	1	2.85
	Frontiers in Education	0.744	1	2.85
Scopus Q2	Vocations and Learning	0.660	2	5.71
	Open Education Studies	0.356	1	2.85
	Journal of Turkish Science Education	0.446	1	2.85
	Applied Sciences	0.555	1	2.85
Scopus Q3	International Journal of Evaluation and Research in Education (IJERE)	0.276	3	8.57
	Cakrawala Pendidikan	0.310	1	2.85
	Journal of Education and Learning (EduLearn)	0.328	1	2.85
Scopus Q4	Journal of Engineering Science and Technology	0.202	1	2.85
	New Educational Review	0.158	1	2.85
	WSEAS Transactions on Business and Economics	0.214	1	2.85
	International Research Journal of Multidisciplinary Scope (IRJMS)	0.141	1	2.85
Total			35	100

Based on the journals obtained, topics from each literature were reviewed and identified as related to soft skills. The identification results showed 12 findings that mapped The Teaching

Factory's influence on soft skills. The findings of TeFa's impact on soft skills include adaptability, communication, teamwork, problem-solving, critical thinking, responsibility, entrepreneurship, creativity, innovation, initiative, leadership, and flexibility. Figure 3 illustrates the distribution of soft skills related to TeFa.

Based on Figure 3, the most dominant soft skills are adaptability, with 111 coding references (22%), followed by communication, with 97

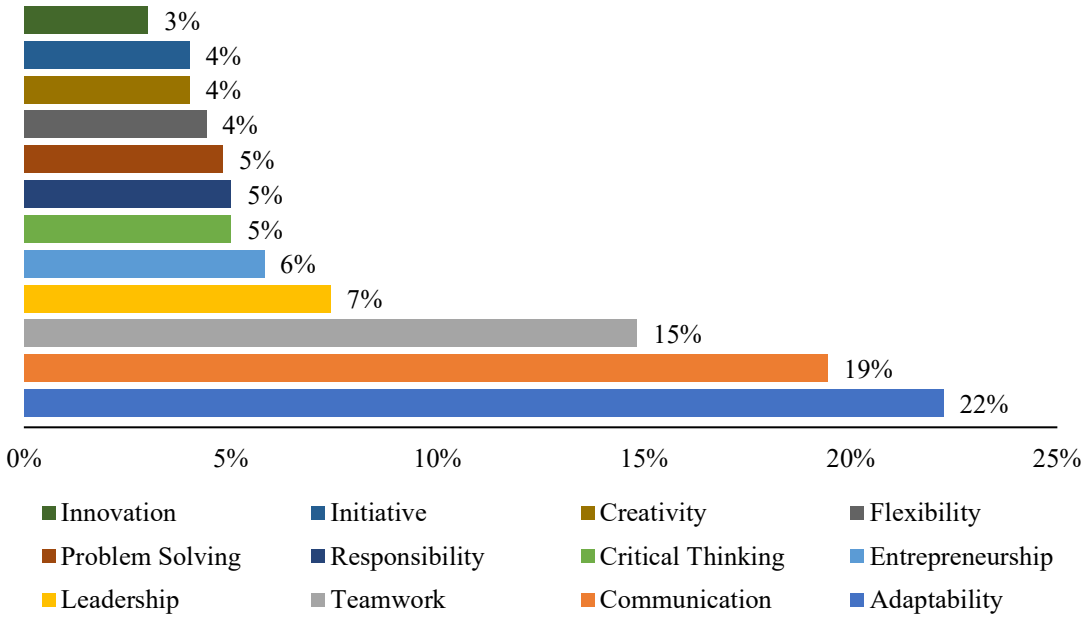

Figure 3. Distribution of the relationship between soft skills and teaching factory in the literature review. Note: Percentages were calculated based on the total number of NVivo coding references (n = 499) identified across the 35 selected articles. The values represent the relative frequency of coded references for each soft skills theme.

references (19%), and teamwork, with 74 references (15%). These findings show that Teaching Factory has had a greater influence on adaptability, communication, and teamwork as core competencies for facing the dynamic industrial environment.

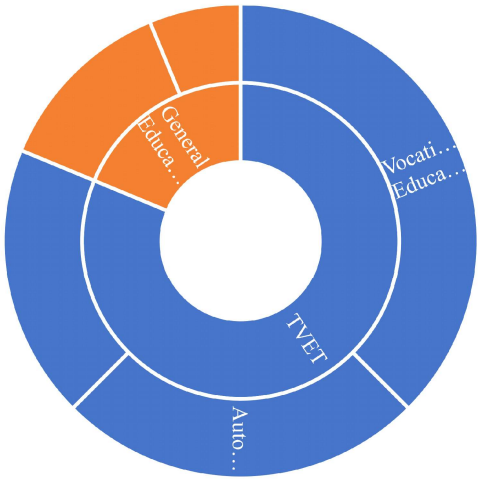

Figure 4. Literature mapping based on field of expertise

To provide a comprehensive overview of the reviewed research landscape, we present the distribution of the literature by area of expertise in a sunburst visualization (Figure 4). This visualization classifies the literature into main categories covering Education and Industry. The diagram shows that the reviewed literature largely focuses on Vocational Education, reflecting the urgency of research on work readiness and competency development. This classification justifies the scope of the selected literature and clarifies the research's position in mapping competency needs aligned with global industry challenges.

Adaptability

Adaptability skills encompass an individual's ability to quickly adapt to changes and developments in the industry. Employees at all levels of expertise must be able to adapt flexibly to changing job requirements, working conditions, and obstacles in the global labor market (Jamaludin et al., 2023). Besides being an effort to survive and face industrial transformation, adaptability plays an important role in maintaining work well-being. Based on NVivo thematic codes, adaptability is defined through five indicators: openness to learning, environmental adaptation, knowing how to act, responsiveness to change, and resilience. These indicators support students in continuously adjusting their abilities through the dynamic industrial environment.

Adaptability makes it easier for someone to manage stress levels and workload while working, so they do not act emotionally or rashly (Dubiel et al., 2025; Marcionetti et al., 2025; Su et al., 2023). A person's adaptive attitude in their career can help them perform better and work more effectively, leading to higher satisfaction (Cai et al., 2023). Adaptability helps people understand their roles and deal with industrial diversity (Thianthai & Sutamchai, 2022). This can increase graduates' productivity and sustainably deliver a positive impact on the industry.

Vocational education significantly improves students' adaptability through academic, social, and work experiences acquired during their learning period (Fang et al., 2024; Wuryanto et al., 2026). Adaptability functions prepare students to meet the evolving demands and realities of the industrial world, such as technological advancements and changing job market requirements. Industry 4.0 and 5.0 are increasing the need for a new generation of engineers who can be productive in the era of digitalization (Mourtzis et al., 2022). In an educational context, cultivating adaptability becomes a strategic function that equips psychology students with readiness for work.

Furthermore, this vocational education aims to equip students with strong hard and soft skills to meet the realities and diversity demands of the industry. Students must be able to explore, create, or develop a product or service with new technology (Wahjusaputri & Bunyamin, 2022). Industrial transformation, driven by technological advances and evolving job market paradigms, requires vocational education graduates to be highly adaptable. Hence, they are ready to meet basic job requirements in their fields. One of the studies stated that an applied metacognitive-based learning model, equipped with information technology facilities as a learning communication tool, will increase graduates' capability to face and adapt to the new world of work (Maksum et al., 2022). This means adaptability also helps students develop a strong work ethic, resilience, and agility in their work so they can thrive amid ongoing industry disruption.

Adaptability is primarily developed through students' direct involvement in authentic industrial production activities, as reflected in the Teaching Factory (TeFa). Unlike conventional vocational practices, TeFa trains students to adapt to the working situations that require continuous

adjustment to changing production targets, varying customer requirements and demands, product and service quality standards, and workplace procedures. Several studies indicate that vocational students are expected to carry out production under industry-like conditions in a school environment, requiring them to respond to operational constraints, coordinate with team members, and adapt their work strategies when unexpected problems arise (Rosidah & Sutirman, 2023; Wahjusaputri & Bunyamin, 2022). This experience encourages students to be more adaptable when facing uncertain changes in the workplace and to meet workplace expectations.

Integrating technology and real-world problems into daily learning activities will develop students' adaptability by exposing them to industry-oriented learning in TeFa (Ramdhani et al., 2025). This aligns with several studies discussing Industry 4.0 and 5.0, the hybrid TeFa model, and technology-enhanced vocational learning, which consistently emphasize that students are required to adapt to evolving technologies, digitalization work systems, and changing job demands (Kozlovsky et al., 2022; Mourtzis et al., 2022; Wahjusaputri, Nastiti, & Liu, 2024). These conditions not only strengthen students' work readiness for future transitions but also support the development of students' career adaptability. Career adaptability has been identified as an important predictor of employability, proactive work behavior, and successful transition from school to the work environment (Cai et al., 2023; Fang et al., 2024; Jamaludin et al., 2023).

Consequently, TeFa's contribution to adaptability extends beyond focusing on students' work readiness, equipping them to respond effectively to future changes in the industrial environment in which they are employed. Adaptability should encompass graduates' ability to continuously learn in response to technological transformations that have a domino effect on labor market demands. This will impact students' work readiness by training them how to act in the workplace environment and develop resilience to face unpredictable industrial situations.

Communication

Communication is essential in the workplace, as individuals need excellent communication skills to interact with those around them. Communication is crucial because it enables individuals to convey ideas and concerns, thereby preventing misunderstandings in every interaction (Wu et al., 2023). Based on NVivo thematic codes, communication is represented by four key indicators: active participation, building relationships, coordinate, and public speaking.

Communication is necessary to establish positive relationships with colleagues, superiors, and consumers (Espina-Romero et al., 2023; Twyford & Dean, 2024). The industry demands high levels of collaboration, so individuals must have excellent communication skills. Without effective communication skills, messages may be distorted or ignored, thereby decreasing customer service performance and leading to a failed communication process (Thianthai & Sutamchai, 2022; Wu et al., 2023). This skill is not only for daily interaction but also for articulating complex ideas, addressing emerging issues, and negotiating solutions efficiently. So that information is conveyed clearly, and no bias is introduced by misunderstandings.

TeFa has proved to be a highly strategic effort to bridge the gap between graduate competencies and dynamic industry demand. The implementation of TeFa encourages effective communication and strong teamwork by dividing real tasks within the project (Wahjusaputri et al., 2024). By engaging students with pedagogical experiences that closely reflect real-world industry situations, TeFa's presence goes beyond mere theoretical instruction. Learning that simulates the real-world industry can improve

students' skills in communication, creativity, and teamwork (Ramdhani et al., 2025; Wuryanto et al., 2026). This ensures that graduates are well-equipped to navigate the complexities of the modern, dynamic workforce.

The reviewed literature indicates that communication skills are developed through production-oriented collaborative activities integrated within the TeFa environment. TeFa requires students to interact continuously with their team, instructors, customers, and industry partners throughout the production process, enabling them to learn more effectively than through conventional learning. Students are expected to communicate and coordinate on production plans, task distribution, operational issues, and the quality of outcomes.

Literature investigating the TeFa-PBL model and industry-integrated learning suggests that communication skills can increase when students actively participate in activities (Imran et al., 2024; Maksum et al., 2024). Students must proactively work on projects, collaborate to identify solutions to actual problems, and participate in production. This requires continuous supportive interaction among all team members. This is reinforced by literature focusing on the development of interpersonal skills, which found that authentic work experiences encourage students to communicate more effectively, negotiate responsibilities, and build professional relationships that resemble interactions in real industrial environments (Rosidah & Sutirman, 2023).

Communication skills reviewed in previous studies were not developed through interactions in conventional learning but through authentic production activities. These production activities require coordination, discussion, and information exchange among individuals with different responsibilities. An industrial-integrated environment increasingly demands better communication and the maintenance of relationships with everyone they might interact with at work. In this era of evolution, communication in contemporary workplaces increasingly involves collaboration across digital platforms and technological systems.

Teamwork

Another important soft skill, besides communication and individual adaptability, is the ability to work collaboratively within a strong team that is simply called teamwork. From the NVivo analysis, teamwork is identified through four indicators: generating ideas, coordinating roles, achieving shared goals, and supporting the team. Teamwork is fundamental to success in an industrial environment across various fields of expertise. In the workplace, most jobs have shifted from individual tasks to tasks that require significant interdependence. It represents that harmony among all team members is essential for smooth production. This is also supported by a study that states one of the fundamental soft skills needed by industry is teamwork (Espina-Romero et al., 2023).

This approach is in line with TeFa, which generally provides real, interdependent work among individuals with different job responsibilities. So, the assessment conducted at TeFa should not resemble an academic assessment that solely measures students' cognitive achievements; it should also include workplace-oriented assessments. This argument is also supported by a statement in the literature that learning in the workplace will use different assessments than at school, because the assessments carried out are more focused on how students can learn and develop within the teams that have been formed (De Vos et al., 2024).

The development of teamwork through TeFa is closely linked to the collaborative nature of production-based learning; students are encouraged to pursue outputs that must be achieved collectively as a team. Several studies

have shown that authentic industry learning environments enable students to complete their projects, assignments, or production activities that mirror real workplace dynamics within teams (Jamaludin et al., 2023; Jing et al., 2023). In these situations, students must be able to negotiate their roles, coordinate their tasks, exchange ideas, and address operational challenges together. Collaborative activities in TeFa often require ongoing interaction between team members. These experiences contribute to the growth of collaboration, shared accountability, and active engagement within a team, which are identified as important attributes in contemporary work environments (Löfgren et al., 2023; Mohammed & Ozdamli, 2024).

Building habits through this industry work simulation task and activities further strengthens competencies, allowing students to experience the social and organizational realities of teamwork before they face them directly in professional positions (Twyford & Dean, 2024). One of the reviewed literature showed that industry evaluation processes increasingly consider how students actively contribute to collective tasks, support group goals, and operate within coordinated work systems (De Vos et al., 2024). This perspective is highly relevant to the implementation of TeFa, where the success of a production is determined by strong and effective team coordination.

Teamwork will develop effectively through direct involvement in production activities, where students are required to coordinate and work together to achieve a shared outcome. This reinforces the idea that learning experiences that mimic work environments can foster competencies that are difficult to develop through conventional classes. Students can learn to coordinate and support team members as they construct ideas together to achieve institutional goals. Replicated work environments help students learn the value of working in a team rather than working in isolation.

Leadership

As the industry dynamics evolve and demand changes, leadership has become an essential soft skill. NVivo analysis represented leadership through four indicators: self-control, confidence, decision-making, and managing team members. To systematically understand these requirements, the reviewed literature indicates that important soft skills include leadership and management skills (Dubiel et al., 2025; Kozlovsky et al., 2022). In this situation, every team needs a strong, capable leader to guide them and manage their operational systems until their organizational goals are achieved. Effective leaders must be able to inspire their colleagues, build collaborative relationships, create a supportive working environment, and take decisive action during critical production phases.

When students operate TeFa, some are responsible for distributing workloads fairly among group members. Project-based and production-oriented learning environments provide opportunities for students to take initiative and influence team performance, thereby developing leadership skills and responsibilities (Indriatno Putra Pratama et al., 2025). Students need to avoid or resolve potential conflicts that arise during implementation. Getting students familiar with these competencies ensures that graduates can assume supervisory responsibilities and meet the critical demands of the contemporary labor market as proactive organizational navigators. Furthermore, studies on Industry 5.0 competencies emphasize that leadership is increasingly recognized as a critical interpersonal skill that impacts various aspects (Dubiel et al., 2025; Jaedun et al., 2024). Good leadership fosters synergistic collaboration, maintains team commitments, and supports organizational effectiveness in a dynamic work environment.

Engaging TeFa activities introduce students to forms of leadership routinely practiced in the workplace, including decision-making,

accountability for output, and managing team dynamics in daily operations. TeFa also cultivates students' abilities to control themselves (self-control) and increase their confidence. The review evidence suggests that leadership competencies emerge through active participation in roles that mimic the work environment. These findings suggest that TeFa provides practical environments for students to develop leadership competencies through decision-making, team coordination, self-control while working, and confidence in producing high-quality output.

Entrepreneurship

The integration of entrepreneurial skills into vocational education aims to shift students' perspectives from being job-dependent to being job creators. Based on NVivo analysis, entrepreneurship is defined by two key indicators: entrepreneurial mindset and business awareness. In the contemporary educational framework, entrepreneurial capabilities are widely recognized as a critical transversal competency that requires students to navigate the complexities of modern industry (Pacher et al., 2023). Entrepreneurial competency involves a complex and holistic understanding of markets, risk management, and the commercial viability of products or services. A strong entrepreneurial spirit can play an essential role in fostering new entrepreneurs, so vocational education can take advantage of this by adopting effective pedagogical methods such as the Teaching Factory, which is highly suitable for application in vocational high schools (Sutiadiningsih & Mahfud, 2023).

By implementing these skills in vocational education, students will learn to integrate their technical skills and personal abilities into something more profitable by considering market opportunities. Vocational education initiatives increasingly emphasize entrepreneurial skills as a key outcome for graduates. Vocational education equips students with entrepreneurial skills, including the mindset and competencies needed to create broader employment opportunities after graduation, rather than simply seeking employment (Wuryanto et al., 2026). Simulated business operations in education help students become accustomed to using the critical commercial intelligence needed to identify profitable market opportunities and manage independent businesses sustainably in a highly competitive market.

Through TeFa, which provides students with authentic experiences, they are encouraged to develop an entrepreneurial mindset and business awareness while strengthening their ability to apply technical skills in productive economic contexts. Developing entrepreneurial skills through TeFa can be more effective because students can become accustomed to carrying out a series of structured production activities, including production planning, resource management, responding to customer needs, and evaluating business results. Students who run production in TeFa, which has an authentic work environment and task arrangement, will become accustomed to these practices. Furthermore, students can master not only entrepreneurial skills but also the ability to recognize opportunities, create value in their products, and be strategic in competitive markets.

Responsibility

Responsibility became one of the fundamental pillars of professional ethics required for working in every field. In NVivo thematic codes, Responsibility is represented by four indicators: Caring work environment, honesty, discipline, and commitment. Responsibility encompasses a deep sense of accountability for both individual actions and the outcomes of collective projects. In industry, responsibility is demonstrated through strict adherence to occupational safety protocols, such as standard operating procedures (SOPs). Furthermore, responsibility is reflected in the quality of the

product or service and in meeting production deadlines.

A professional with a high level of responsibility and concern for sustainability is expected to make decisions and act in environmentally friendly, socially acceptable, and economically viable ways (Chinedu et al., 2023). When students internalize responsibility in their work, their reliability and integrity will be honed and become more visible. An authentic production environment exposes students to real work expectations that require reliability, discipline, and professional behavior (Rosidah & Sutirman, 2023). These enable students to realize the importance of responsibility in maintaining performance and meeting the industry requirements. Developing students with a strong sense of responsibility can be achieved through structured teaching methods, such as consultation, planning, inspection, and evaluation (Tian & He, 2024).

TeFa forces students to practice responsible behavior throughout the production process until it becomes an internalized professional habit. These comprehensive learning methods will produce graduates with better behavioral characteristics that uphold the rigorous standards expected in a stressful industry environment. This is also crucial for gaining the trust of colleagues, superiors, and clients, thereby strengthening professional relationships in the workplace. At the end, students' responsibility becomes embedded in their daily work practices rather than being treated as a behavioral expectation. In TeFa, the orientation of maintaining product/service quality forces students to consistently practice responsibility until it becomes an internalized professional habit. Therefore, TeFa can transform responsibility from an abstract value into an active professional habit. This ensures that graduates are operationally prepared to meet the industry's rigorous expectations.

Critical Thinking

In the rapidly evolving professional world, workers are expected to go beyond simply following standard operating procedures. The urgency of these skills is emphasized by the World Economic Forum's report (2020), which states that critical thinking and analysis are among the top skills demanded by employers in 2025 (Jaedun et al., 2024). To match this statement, critical thinking is defined as students' ability to anticipate potential failure, critically synthesize disparate information, become objective when judging, and apply a critical mindset when responding to workplace situations. This definition was derived from thematic coding in NVivo and is represented by three key indicators: anticipating failure, objective judgment, and critical mindset.

This also allows them to objectively assess the validity of various technical concepts or methods used during production. Cultivating a robust analytical mindset in students requires a specific pedagogical intervention. Empirical evidence suggests that industry-integrated learning environments are highly effective and have significantly developed students' soft skills, such as critical thinking, creativity, and cognitive flexibility (Kozlovsky et al., 2022). Several studies have stated that, in vocational education, approaches such as the Teaching Factory Based on Troubleshooting (TeFa-T) model have demonstrated immediate potential to enhance students' critical thinking skills (Maksum et al., 2022). Tefa-T provides students with real problems that can arise in an industrial environment. Therefore, by fostering an analytical mindset in students, vocational education prepares graduates to navigate the complexities of the industrial world.

The reviewed studies indicate that critical thinking tends to develop when students are challenged to evaluate the causes of production failures, assess available information, and form

objective judgments before taking action. Through the TeFa program, students gain authentic experience in applying critical thinking competencies through industry-integrated learning environments. These findings indicate that students train to anticipate production failures and can give an objective judgment as an interpretation of a critical mindset.

Problem Solving

Problem-solving is an important skill for students that supports their work readiness. These skills help students learn to identify and resolve operational issues that arise in the workplace. Within the context of TeFa implementation, students are trained in key skills relevant to industry work, from planning and production to managing their own businesses. For example, in culinary programs at vocational schools, students are provided the opportunity to simulate real-world conditions in the culinary industry by formulating menus within a predetermined budget, calculating accurate production costs, and making products that meet industry standards.

In this study, problem-solving is defined as students' ability to identify workplace problems, generate appropriate solutions, and resolve operational conflicts/problems that emerge during authentic production activities. This definition is derived from thematic coding conducted using NVivo and represents the problem identification, solution generation, and conflict handling codes.

The studies in this review indicate that problem-solving skills are developed when students are exposed to real-world situations in which unavoidable problems arise. TeFa Troubleshooting (TeFa-T) approaches place specific emphasis on problem-solving tasks, including group discussions and collaborative examination of production problems (Maksum et al., 2022). These integrated problem-solving tasks create opportunities for students to strengthen their skills through a practical rather than theoretical approach. Besides that, there has been a shift in industry perspectives, in which employees are expected to effectively handle conflicts and offer alternative solutions to complex problems (Jaedun et al., 2024; Yoto et al., 2024).

Teaching Factory supports students' problem-solving development by placing students in realistic work contexts. Students can strengthen their problem-solving skills by being required to manage conflict, identify workplace problems, and generate effective solutions in industry-like environments. TeFa has become an ideal place to develop students' capabilities to solve real-life problems quickly and accurately.

Flexibility

Dynamic changes in the global situation make the demand for the employee's flexibility increase, especially among young professionals. Based on NVivo thematic coding results, flexibility is defined through adjustment action indicators. While adaptability and flexibility are closely related, they represent different dimensions in employability. Flexibility refers to the cognitive and behavioral agility that enables an individual to modify actions, roles, strategies, or work approaches in response to short-term operational changes and unexpected workplace situations.

For vocational graduates, this flexibility indicates the ability to quickly adapt their competencies in response to technological developments, changes in consumer preferences, and sudden disruptions. Vocational learning environments should prepare students to master technical competencies while simultaneously navigating unpredictable real-world situations and the dynamic market demands (Vargas et al., 2023). The balanced integration of soft and hard skills in industry-oriented learning enables students to develop the flexibility to modify strategies, evaluate alternatives, and respond effectively to a changing workplace (Kozlovsky et al., 2022). In this era, careers are becoming

increasingly non-linear, discontinuous, and volatile, requiring flexibility from everyone to achieve sustainable career success (Cai et al., 2023). To face these situations, flexibility is required in response to emerging technologies, shifting labor market demands, and evolving professional roles, making it a crucial competency for long-term career sustainability (Espina-Romero et al., 2023).

Teaching Factory provides students with the opportunity to carry out production processes in accordance with industry standards, requiring them to adjust their actions without compromising quality or efficiency. However, the reviewed literature indicates that flexibility in contemporary vocational education goes beyond maintaining productivity and performance in unpredictable workplace situations. Flexibility develops when students are repeatedly exposed to dynamic workplace situations that require continuous adjustment. Through TeFA, students gain authentic experiences in response to changing workplace demands, enabling them to remain effective in real-world industrial environments.

Creativity

Creativity became an essential domain with unlimited dimensions in industry. In NVivo thematic codes, creativity is defined by two indicators: generating ideas and creating. From these thematic codes, creativity serves as a bridge between innovation thinking and the development of products or services that meet industrial standards. Creative thinking can foster habits in students that help them break free from the rigid paradigms of traditional education, enabling them to explore ideas and experiment with their work.

Vocational education must encourage students to become more active and creative in obtaining information and seeking solutions to problems encountered during the learning process (Maksum et al., 2022). One of the reviewed studies stated that creativity is a skill targeted and emphasized in the 21st century (Mohammed & Ozdamli, 2024). Creativity fosters students' ability to create their own solutions to novel problems and introduces new ways of performing tasks (Cai et al., 2023; Vargas et al., 2023). This is an important factor influencing continuous improvement, positioning graduates as active contributors to creating value for the institution (Rosidah & Sutirman, 2023).

Creativity is about generating new ideas to address conventional operational constraints. In a highly competitive industry, the ability to conceptualize and create innovative product variations or to optimize existing service delivery models is highly valued. Through TeFa, students have opportunities to experiment, explore alternative approaches, and participate in real-world industry projects. These situations involve students learning to transform ideas into tangible products or services with unique characteristics without deviating from industry standards.

Initiative

Initiative refers to interpersonal skills that include personal desire and a proactive attitude toward identifying and handling tasks without requiring external direction or constant supervision. In NVivo, thematic codes conceptualize initiative as three indicators: seeking information, willingness to learn, and proactive action. The broader context of professional development is proactive behavior, defined as self-initiated action to create change, which has become crucial for both organizational goals and individual career success (Cai et al., 2023). In the dynamic, fast-paced flow of industrial environments, employees with high initiative can significantly reduce the supervisory burden on management, thereby increasing overall organizational efficiency (Wahjusaputri & Bunyamin, 2022).

Vocational education fosters students' initiative skills by providing a simulated industrial

learning environment in the Teaching Factory program. Students are fully responsible for initiating project stages, sourcing necessary resources, and proactively mitigating potential hazards. To further encourage this self-directed attitude, TeFa implementations often integrate digital learning environments with various information and communication technologies, in which the administration of teaching materials is carried out autonomously (Wahjusaputri et al., 2024).

Initiative skills reflect a person's readiness for a professional career, signaling to the industry that a vocational graduate possesses the intrinsic motivation needed to accelerate business growth. The reviewed studies indicate that initiative develops when students are given independent tasks, seek relevant information, and act without waiting for direct instructions. TeFa facilitates the repetition of activities and the formation of work habits so that students not only follow instructions but also internalize the self-directed work culture required by industry. These findings suggest that initiative is a competence that can be systematically developed to prepare graduates to actively contribute to the dynamic industry.

Innovation

Innovation is the application of creativity and problem-solving skills to drive discoveries that significantly impact the evolution of industry. Based on the NVivo thematic coding results, innovation is represented by the indicator of innovative thinking. While creativity generates new ideas, innovation applies these ideas to concrete, practical applications that produce measurable improvements in products, services, or organizational management. On a global scale, according to the World Economic Forum's (2020) report, innovation is among the top skills employers will demand by 2025 (Jaedun et al., 2024).

To address this, especially in the context of sustainable industrial development, vocational education must further leverage the industry's operational framework by streamlining processes and improving the overall quality of outcomes. Vocational education must provide real-world industrial environments so educators can teach students how to continuously streamline processes and improve overall outcomes. Innovation has become an increasingly important competency for graduates to possess as industries now seek workers who not only contribute through their technical competencies but also have the ability and willingness to support organizational competitiveness, which is seen as a continuous improvement initiative (Daryono et al., 2023).

Cultivating an innovative mindset in students throughout their education will ensure that graduates are prepared to meet current workforce demands and fully equipped to spearhead future industrial advancements. While doing production in TeFa, innovation becomes more tangible through functional competencies, as students are required to overcome technical obstacles that arise in industry, with operational limitations and precision requirements mirroring those in the actual industrial and commercial sectors. By consistently applying innovative skills to solve real production challenges, students transform innovation into stable professional habits. These findings indicate that TeFa, through authentic learning situations, effectively cultivates innovative thinking that supports graduates' employability and competitiveness as they transition from education to the workplace.

Teaching Factory is designed to enable students not only to master their technical competencies but also to strengthen their soft skills (Hulyadi et al., 2025; Indriatno Putra Pratama et al., 2025; Jaedun et al., 2024; Kozlovsky et al., 2022; Tikhonova & Raitskaya, 2023). This is consistent with the literature, which indicates that students who master only technical competence but lack interpersonal competence (soft skills) have a limited capacity to adapt and advance in their careers (Davila Laguna et al.,

2025; Löfgren et al., 2023). Another study supported this by stating that vocational schools better prepare students by addressing the listed difficulties and using the TeFa model (Isnandar et al., 2023). Furthermore, other literature indicates that when students can detect and correct common, sudden errors, they can solve a new problem. They then realize the importance of adhering to established standards as a form of responsibility and discipline in their work (Vargas et al., 2023). This is reinforced by other literature, which states that students learn to make useful products or provide useful services that address identified problems or issues (Chinedu et al., 2023). Thus, the existing literature shows that the TeFa implementation has a significant impact on increasing students' employability.

The effectiveness of TeFa implementation in developing professional character is firmly rooted in Charles Allen Prosser's theorems, particularly the first, second, and sixth theorems (Yunus et al., 2023). The first theorems state that vocational education will be more effective and efficient if students are taught in a learning environment that closely mirrors the real world of industry. The second theorem states that vocational education will be more effective if the tasks assigned in training are operationally similar to those in real industry and use the same equipment and machinery. The sixth theorem states that vocational education will be effective if the training provided through specific experiences can be embodied in correct habits of action and thought through repeated practice.

The synthesis of the reviewed articles provides strong evidence of the relevance of Prosser's theorems to vocational education. Prosser's theorem is expanded beyond the development of technical competencies to include the development of soft skills related to employability. Although Prosser emphasizes authentic industrial and task environments as well as repetitive practical experience, the findings suggest that these elements can develop soft skills. Several reviewed studies clearly show that TeFa provides an authentic industry learning environment. It is suggested that the relevance of Prosser's theorem in contemporary vocational education lies not only in preparing students to master technical competency but also develop professional behavior and soft skills necessary for a successful transition to a dynamic labor market environment. Exposure to an authentic learning environment gradually transforms the soft skills taught to students into professional habits.

TeFa integrates real production-based activities through project-based learning, work procedures according to industry standards, and real interactions in the workplace into vocational learning (Isnandar et al., 2023; Rosidah & Sutirman, 2023). Integrating real industry conditions into the school curriculum through TeFa will enable students to transition from theoretical learners to professionally responsible practitioners (Daryono et al., 2023). Through the authentic experience in TeFa, students are exposed to production targets, quality control procedures, customer demands, and collaborative work that closely resemble industrial practices. This situation can effectively bridge the gap between learning at school and expectations in the world of work.

Within TeFa, repeated engagement in quality control and service-based production forces students to practice core behaviors until these actions become internalized as professional habits (Maksum et al., 2022; Rosidah & Sutirman, 2023). These activities contribute to the development of students' soft skills. In the reviewed studies, soft skills such as adaptability, communication, teamwork, problem-solving, critical thinking, leadership, responsibility, entrepreneurship, flexibility, creativity, initiative, and innovation were developed through repeated engagement with industry-oriented tasks, production processes, and workplace interactions

that closely resemble real-world work environments. Consequently, TeFa effectively ensures that graduates are prepared to meet the demanding expectations of the contemporary workplace (Yoto et al., 2024). Vocational education must now prepare students to respond to digital transformation, interdisciplinary collaboration, sustainability challenges, and innovation in industrial environments.

Based on the existing literature, TeFa contributes to student work readiness by integrating technical and soft skills. The impact of TeFa on the development of soft skills is increasing in the contemporary workplace. This integration can be achieved through an authentic learning environment that reflects TeFa. Therefore, the effectiveness of TeFa lies in its ability to create authentic learning by integrating an industry environment as closely as possible, as stated in Prosser's first theorem. It will affect vocational graduates' readiness to transition from education to the world of work.

The successful implementation of TeFa to shape students' professional character depends on the extent to which schools can integrate the industrial practice environment directly into their classrooms. Furthermore, TeFa implementation must also accommodate the skills needed in the 21st century, namely the 4Cs (Critical Thinking, Communication, Creativity, and Collaboration) (Mohammed & Ozdamli, 2024). By optimizing TeFa in schools, students will gain their skills comprehensively and productively, both basic and professional, to support their future working life (Pacher et al., 2023; Tian & He, 2024). In the 4.0 revolution, educators must shift from teacher-centered learning to student-centered learning, integrating ICT and fostering an interest in lifelong learning (Mourtzis et al., 2022). This practical experience shows that students can develop soft skills to support their independence in learning and shift the educator's role to that of a facilitator. Despite its positive impact on soft skills, challenges remain in the TeFa implementation process, including resistance from educators, limited resources, and insufficient staff training.

As a concrete solution to the competency gap, strengthening soft skills must be integrated into the curriculum. Therefore, vocational graduates must have a professional character that is properly developed and nurtured during their education. Strong and strategic collaboration between schools and industry is essential to prepare students to become future workers who need relevant competencies, such as providing inclusive learning and achieving the Sustainable Development Goals (SDGs) (Jing et al., 2023; Yoto et al., 2024). Keeping TeFa's management broad and connected to the industry is important for making vocational graduates more employable and competitive in the job market (Sutiadiningsih & Mahfud, 2023; Twyford & Dean, 2024). As an optimal effort, vocational graduates must have a strong professional identity, mental resilience, and appropriate social skills as part of their identity formation in the workplace (Jamaludin et al., 2023). These can administer these initiatives to ensure that vocational graduates possess the ability and talent for both gentle and difficult skills. This will enable graduates to adapt and be more flexible in response to the real, dynamic demands of the workplace.

These studies have consistently shown that the Teaching Factory Implementation in vocational education has greater benefits than mastering technical skills. Studies also suggest that industrial-like work environments naturally foster the development of various essential soft skills for students. This confirms that production- or service-based vocational learning, adapted to industrial work environments, can ensure that vocational graduates are not only mechanically skilled but also work-ready.

Beyond identifying individuals' soft skills, the reviewed literature suggests that these skills are developed as interconnected competencies

rather than isolated attributes. Based on the synthesis of the literature, these competencies can be classified into broader thematic clusters according to their contribution to vocational students' work readiness. The meta-themes were constructed through qualitative clustering following the NVivo thematic synthesis process. The clustering was based on conceptual similarity and on each competency's dominant contribution to vocational students' work readiness. This approach is consistent with recent ESCO-related studies that conceptualized employability as interconnected competency clusters rather than independent skills (Panzaru & Grama, 2025; Shellshear & Oh, 2025; Winch, 2023). The result is presented in Table 5.

Table 5. Meta-Themes of soft skills development through teaching factory implementation

Meta-Theme	Soft Skills	Main Contribution
Adaptive Competencies	Adaptability, Flexibility, Initiative	Respond to changes in technology, dynamic workplaces, and evolving labor market demands.
Collaborative Competencies	Communication, Teamwork, Leadership, Responsibility	Strengthening students' ability to collaborate and navigate professional roles
Value Creation Competencies	Critical Thinking, Problem Solving, Creativity, Innovation, Entrepreneurship	Analyze workplace changes, generate solutions, identify opportunities, and contribute to continuous improvement.

Methodological transparency and evaluation of the assessment instruments used in the original literature are crucial. The reviewed literature consistently states that TeFa can improve vocational students' work readiness. A description of how these competencies are empirically measured in the field is necessary to validate the robustness of these claims. To illustrate this, Table 6 represents a synthesis of the types of empirical evaluation instruments validated and used by the 35 articles reviewed.

Table 6. Empirical assessment instruments used in the reviewed studies

Assessment Instrument	Instrument Type	%	Source
Questionnaire	Standard Likert scales, self-report psychological inventories (CAAS, PPS), and expert validation (Delphi Method)	62.86	(Cai et al., 2023; Chinedu et al., 2023; Daryono et al., 2023; Davila Laguna et al., 2025; Fang et al., 2024; Hulyadi et al., 2025; Isnandar et al., 2023; Jaedun et al., 2024; Kozlovsky et al., 2022; Löfgren et al., 2023; Maksum et al., 2022; Marcionetti et al., 2025; Pacher et al., 2023; Su et al., 2023; Sutiadiningsih & Mahfud, 2023; Twyford & Dean, 2024; Vargas et al., 2023; Wahjusaputri et al., 2024; Wahjusaputri & Bunyamin, 2022; Wu et al., 2023; Wuryanto et al., 2026; Yoto et al., 2024)
	Behavioral observation,	20.00	(Hulyadi et al., 2025; Isnandar et al., 2023; Mourtzis et al., 2022; Rosidah &

Observation	teamwork rubrics, workplace performance observation, participatory field notes		Sutirman, 2023; Wahjusaputri & Bunyamin, 2022; Wuryanto et al., 2026; Yoto et al., 2024)
Interview	Semi-structured interviews, in depth interview, FGD	20.00	(Isnandar et al., 2023; Jaedun et al., 2024; Rosidah & Sutirman, 2023; Thianthai & Sutamchai, 2022; Wahjusaputri et al., 2024; Wahjusaputri & Bunyamin, 2022; Yoto et al., 2024)
Product Evaluation	Product quality assessment, prototype assessment, project outcomes, innovation outputs	5.71	(Mourtzis et al., 2022; Ramdhani et al., 2025)
Performance Test	Practical skill assessment	2.86	(Tian & He, 2024)

CONCLUSION

Based on a literature review of 35 articles published between 2022 and 2026, Teaching Factory implementation has a positive relationship with and significantly improves the work readiness of vocational high school graduates by providing authentic learning experiences and environments. TeFa has been shown to improve vocational students' work readiness primarily by fostering professional attitudes and soft skills. The findings identified 12 soft skills associated with TeFa implementation, including adaptability, communication, teamwork, problem-solving, critical thinking, leadership, flexibility, creativity, initiative, responsibility, entrepreneurship, and innovation. Among these competencies, the most frequently reported soft skills influenced by TeFa are adaptability (22%), communication (19%), and teamwork (15%). Rather than developing these competencies independently, the literature reviewed indicates that TeFa comprises 3 interrelated groups of soft skills: adaptive, collaborative, and value-creation competencies. Collectively, these clusters provide an integrated foundation for supporting students' readiness for the transition from school to work.

In TVET, the development of independent and mentally resilient individuals is significantly influenced by the school's ability to establish a realistic work environment, as outlined in Prosser's theory. The effectiveness of Tefa depends on the school's ability to expose students to the real production process, industry standards, a real workplace environment and interactions, and similar tasks (job responsibilities) that facilitate the formation of professional habits and competencies. So that TeFa is considered not only a traditional industrial practice but also a response to the demands of digitalization, industry transformation, and increasingly dynamic career environments.

Despite its positive contributions, the implementation of TeFa still faces challenges related to industrial partnerships, infrastructure availability, financial resources, and variations in educator competencies. This literature indicates that there is still a need for a systematic implementation mechanism to ensure that

opportunities for soft skills are consistently experienced across vocational education. Future research questions that can be formulated are:

RQ 1. Which components of the TeFa implementation are consistently associated with the development of soft skills among vocational students?

RQ 2. How do contextual factors, including school-industry partnerships, authentic learning environments, educator competency, and institutional resources, influence the effectiveness of TeFa implementation?

RQ 3. How can evidence-based implementation guidelines be developed to ensure consistent soft skill development and work readiness across vocational education?

These efforts are expected to support the implementation of TeFa in a more consistent, effective, and sustainable manner while strengthening vocational students' work readiness.

■ DECLARATION OF GENERATIVE AI USAGE IN THE WRITING PROCESS

During the preparation and revision of this manuscript, the author(s) used ChatGPT (OpenAI) to assist with language editing, paraphrasing, improving sentence structure, and enhancing the clarity and coherence of academic writing. The author(s) carefully reviewed, edited, and verified all outputs generated by the tool and take full responsibility for the accuracy, originality, and integrity of the final manuscript.

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