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Teaching Factory-Based Entrepreneurship Learning in Vocational High Schools: A Multi-Site Study of School-Industry Collaboration

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Abstract

This study examines how entrepreneurship learning in vocational high schools is implemented through collaboration between schools and business and industry partners based on the Teaching Factory model. Using a qualitative multi-site design, the research was conducted in 16 vocational high schools across South Sumatra. Data were collected through observation, semi-structured interviews, and document analysis involving principals, curriculum or industry-relations vice principals, Teaching Factory coordinators, entrepreneurship teachers, productive teachers, industry partners, and students. The findings show that entrepreneurship learning within Teaching Factory is not merely a technical production practice but a learning system that connects school policy, curriculum integration, teacher roles, industry involvement, and students' learning experiences. The depth of school-industry collaboration shapes the quality of students' entrepreneurial learning, especially in developing discipline, responsibility, initiative, teamwork, self-confidence, and business orientation. Strong implementation is supported by leadership commitment, teacher collaboration, production units, and substantive partner involvement, while limited facilities, uneven industry participation, unstable practice schedules, and weak administration remain constraints. The study concludes that Teaching Factory should be positioned as an entrepreneurial learning ecosystem in vocational education.

Keywords: Teaching Factory, entrepreneurship learning, school-industry collaboration, vocational education

INTRODUCTION

Vocational High Schools (Sekolah Menengah Kejuruan/SMK) are designed to prepare graduates with competencies aligned with the needs of business and industry (Dunia Usaha dan Dunia Industri/DUDI) (Rahmadhani & Suryati, 2022). However, the demands placed on SMK graduates today extend beyond mere readiness to enter the workforce (Sohidin, 2018). This issue remains highly relevant in Indonesia, as the Central Statistics Agency reported that the open unemployment rate among vocational high school graduates reached 8.63% in 2025, higher than that of general senior high school graduates (Sunggoro et al., 2022). At the policy level, Presidential Regulation No. 68 of 2022 on the Revitalization of Vocational Education and Vocational Training also emphasizes the need to improve the quality and relevance of vocational education in accordance with labor market needs and to equip human resources with competencies for work and/or entrepreneurship (Igwe et al., 2022). Therefore, graduates are also expected to possess adaptability, the ability to identify opportunities, the courage to take initiative, and an entrepreneurial orientation in order to survive and grow in an increasingly dynamic world of work (Bhoyar et al., 2025). In this context, entrepreneurship learning has become an important component of vocational education, not only to equip students with

knowledge about business, but also to develop attitudes, values, and experiences that encourage economic independence.

In practice, entrepreneurship learning in SMKs still faces fundamental challenges. Empirical evidence from a qualitative case study at SMK Teknologi Industri Muhammadiyah Cikampek showed that project-based entrepreneurship learning had not been implemented optimally; learning activities were still - plan-based entrepreneurship learning at SMK Putikecwara Batu found that although entrepreneurship materials had included business plan preparation, the learning process still focused more on theory than on practical business-plan skills, and project-based learning was only partially implemented (Chryssolouris et al., 2016). These findings indicate that students may understand business concepts cognitively, but they do not always gain sufficient direct experience in how a product or service is planned, produced, marketed, delivered, and evaluated. As a result, entrepreneurship learning has not always been able to concretely develop students' initiative, responsibility, creativity, self-confidence, and business orientation (Igwe et al., 2022). This condition indicates that entrepreneurship learning in SMKs requires a more contextual and experience-based approach that is closely connected to authentic business situations.

One relevant approach to addressing this need is the Teaching Factory. In vocational education, the Teaching Factory is understood as a production-based learning model for goods and/or services that incorporates industrial quality standards, work procedures, and work culture into the school environment (Saputro, 2024). Through the Teaching Factory, students not only learn technical skills but also engage in real work processes that include planning, implementation, service delivery, packaging, promotion, and evaluation of outcomes (Chryssolouris et al., 2016). With these characteristics, the Teaching Factory has the potential to become a more dynamic, authentic, and meaningful space for entrepreneurship learning (Oliver & Oliver, 2022).

A number of previous studies have shown that the Teaching Factory can strengthen vocational learning, bring students closer to industrial work culture, and improve work readiness (Prianto, 2021). Other studies have also emphasized that entrepreneurship learning is important for fostering students' creativity, independence, and courage in identifying business opportunities (Karimi et al., 2016). Meanwhile, studies on partnerships between SMKs and DUDI have generally highlighted the importance of institutional collaboration, curriculum synchronization, workplace practice, and strengthening the relevance of vocational education to labor market needs (Suyetno et al., 2024). These findings indicate that Teaching Factory, entrepreneurship, and SMK-DUDI collaboration have already received attention in vocational education research.

However, these studies still leave an important gap. Most existing research tends to examine the Teaching Factory as a means of strengthening technical skills, entrepreneurship as a subject area or a separate competency outcome, or SMK-DUDI collaboration as a matter of institutional arrangements and formal partnerships. Studies that specifically examine how entrepreneurship learning is actually implemented through Teaching Factory-based collaboration between SMKs and DUDI as an integrated learning system remain limited (Anggia, 2020). Such a system involves the interconnection of school policy, curriculum, teachers, industry partners, production or service processes, and students' learning experiences in daily practice. This is where the present study identifies its research gap.

This gap is significant because the success of entrepreneurship learning in SMKs cannot be adequately explained solely by the presence of a Teaching Factory unit, the existence of collaboration documents with DUDI, or the availability of entrepreneurship subjects in the classroom (Rohaeni et al., 2021). What matters more is how these elements are integrated into real, repeated, and meaningful learning experiences for students. In other words, the main issue is not merely whether a Teaching Factory exists or whether a school

has partnered with DUDI, but whether such collaboration truly enters the learning space and concretely shapes students' entrepreneurial experiences (Kuh, 2016). This aspect has not been sufficiently explored, particularly through qualitative multi-site studies that allow for a more comprehensive understanding of variations in practice across schools.

To address this issue, the present study employs several complementary conceptual lenses (Blagoev & Kunisch, 2024). First, experiential learning places direct experience at the center of the learning process, meaning that entrepreneurship learning is understood not merely as receiving concepts, but as experiencing, reflecting, understanding, and trying again in real situations (Motta & Galina, 2023). Second, work-based learning emphasizes that learning becomes stronger when it takes place in an authentic work context characterized by quality demands, targets, service, and real problem-solving (Brook & Corbridge, 2016). Third, school-industry partnership provides a framework for understanding that the quality of vocational learning is determined not only by schools, but also by the depth of DUDI involvement in the learning process (Kasanah et al., 2025). Fourth, entrepreneurial learning helps explain that entrepreneurial orientation develops through active engagement in value creation, decision-making, opportunity recognition, interaction with users, and continuous improvement, rather than through lectures or conceptual instruction alone (Srivastava et al., 2022).

Through these lenses, the Teaching Factory is not understood merely as a place for production practice, but as a learning space that allows students to experience work processes and business processes simultaneously (Pontevedra et al., 2019). In this context, collaboration between SMKs and DUDI becomes important not only because it provides facilities or institutional legitimacy, but also because it brings industrial standards, quality logic, service culture, and market orientation into students' learning experiences (Wahyudin et al., 2022). Thus, Teaching Factory-based entrepreneurship learning can be understood as the intersection of experiential learning, authentic work contexts, institutional partnerships, and the formation of entrepreneurial orientation (Jing et al., 2023).

On the other hand, the implementation of the Teaching Factory does not follow a single pattern across SMKs. Differences in school policy, infrastructure readiness, program characteristics, the intensity of DUDI involvement, teacher capacity, and local environmental conditions make the implementation of Teaching Factory-based entrepreneurship learning highly diverse (Nurfadlilawati et al., 2022). In some schools, the Teaching Factory functions as an integrated learning system and provides students with strong entrepreneurial experiences (Anggia, 2020). In others, it remains limited to production or service activities that are not yet fully connected to the goals of entrepreneurship learning (Halberstadt et al., 2019). This variation is important to investigate in order to gain a more comprehensive understanding of how entrepreneurship learning is actually carried out in practice (Pittaway & Edwards, 2012).

Based on this background, the present study examines entrepreneurship learning through Teaching Factory-based collaboration between SMKs and DUDI in 16 vocational high schools in South Sumatra. This study positions the Teaching Factory not merely as a practice unit, but as an entrepreneurial learning ecosystem that connects school policy, curriculum, teachers, industry partners, and students' authentic business experiences. To guide the Methods, Results, and Discussion sections, this study addresses the following research questions: 1) What patterns of collaboration between SMKs and DUDI are implemented through Teaching Factory-based entrepreneurship learning in 16 SMKs in South Sumatra? 2) How do students experience entrepreneurship learning in the Teaching Factory, and what roles are played by DUDI in supporting authentic business practices? 3) How does Teaching Factory-based collaboration contribute to students' entrepreneurial orientation, and what supporting and inhibiting factors affect its implementation?

METHOD

This study employed a qualitative multi-site case study design (Campbell et al., 2020). This design was selected because each vocational high school was treated as a bounded case of Teaching Factory implementation, while the 16 cases were examined collectively to identify both site-specific dynamics and cross-site patterns. Methodologically, a multi-site or multiple-case study is appropriate when researchers seek to investigate a contemporary educational phenomenon in its real-life context and compare how the phenomenon is implemented across different institutional settings (Campbell et al., 2020). Therefore, this study did not aim to statistically test relationships among variables, but to gain an in-depth and contextual understanding of how entrepreneurship learning among vocational high school students was implemented through Teaching Factory-based collaboration between schools and business and industry. The multi-site design also allowed the researchers to compare patterns of collaboration, forms of students' learning experiences, the role of DUDI, and the supporting and inhibiting factors affecting implementation across schools in South Sumatra. In this study, the Teaching Factory was understood as a production-based learning model for goods and/or services that adopts industrial quality standards and work procedures while simultaneously serving as a medium for developing students' entrepreneurial experiences (Zhang et al., 2023).

The research sites consisted of 16 vocational high schools in South Sumatra, which were purposively selected based on regional representation, the vocational characteristics of the schools, and the potential for implementing Teaching Factory-based learning through collaboration with business and industry. A complete list of schools, locations, and the rationale for their selection is presented in Table 1.

Table 1. Multi-Site Research Locations and Rationale for Site Selection

No.	School Name	Regency/City	Rationale For Selection
1	SMK Negeri 01 Palembang	Palembang City	Represents a public vocational high school located in the city center and in an urban industrial/service environment
2	SMK Negeri 03 Palembang	Palembang City	Represents a public vocational high school in a major city with broad potential for business and industry networking
3	SMK Negeri 8 Palembang	Palembang City	Represents an urban public vocational high school with potential for practice-based learning
4	SMK Negeri 1 Lubuklinggau	Lubuklinggau City	Represents the western region of South Sumatra and the context of a medium-sized city
5	SMKN 2 Prabumulih	Prabumulih City	Represents an industrial/energy city with potential for partnership with business and industry
6	SMKN 1 Ogan Komering Ulu	Ogan Komering Ulu Regency	Represents a vocational education center in the OKU region
7	SMKN 2 Ogan Komering Ulu	Ogan Komering Ulu Regency	Provides variation in vocational school contexts within the same regency
8	SMKN 1 Lahat	Lahat Regency	Represents the context of a regency-based vocational high school with a developing vocational ecosystem
9	SMKN 1 Muara Enim	Muara Enim Regency	Relevant to the regional industrial and employment context
10	SMKN 1 Gelumbang	Muara Enim Regency	Represents the buffer area of the Palembang-Prabumulih economic corridor

11	SMKN 1 Lubai Ulu	Muara Enim Regency	Provides variation in regency-based school contexts outside the urban center
12	SMKN Muara Beliti	Musi Rawas Regency	Represents the Musi Rawas region with a non-urban vocational character
13	SMK Negeri 2 Pagar Alam	Pagar Alam City	Represents the context of a highland city with local entrepreneurial potential
14	SMKN 1 Martapura	East Ogan Komering Ulu Regency	Represents the eastern region of South Sumatra
15	SMK Negeri 1 Indralaya Utara	Ogan Ilir Regency	Represents an area adjacent to higher education institutions with access to business and industry around Palembang
16	SMKN 1 Banyuasin III	Banyuasin Regency	Represents the Banyuasin area with potential for local business and service networks

The study used both primary and secondary data sources. Primary data were obtained from 144 participants across 16 SMKs in South Sumatra. The participants consisted of 16 school principals, 16 vice principals for curriculum or industrial relations, 16 Teaching Factory coordinators, 16 entrepreneurship teachers, 16 productive subject teachers, 16 business and industry partners, and 48 students involved in practice-based entrepreneurship learning. Data collection included 96 individual interviews with school leaders, teachers, Teaching Factory coordinators, and business and industry partners, 16 focus group discussions with students, and 16 Teaching Factory observations. The interviews explored school policy, curriculum implementation, collaboration mechanisms with DUDI, students' entrepreneurship learning experiences, and supporting and inhibiting factors affecting the implementation of the Teaching Factory. The observations focused on production or service activities, student participation, teacher facilitation, industry involvement, and the use of Teaching Factory facilities. Secondary data were drawn from school profile documents, curriculum documents, teaching materials, collaboration agreements with business and industry, Teaching Factory activity schedules, activity reports, production reports, and other supporting documentation. Details of the data sources, participant categories, roles of informants, and the number of participants from each category are presented in Table 2.

Table 2. Data Sources, Informants, Roles in the Study, and Target Number of Participants

Data Type	Informant/Source	Role in the Study	Target
Primary	Principal	Explaining school policy, institutional support, and the direction of SMK-DUDI collaboration	1
Primary	Vice Principal for Curriculum/Industrial Relations	Explaining curriculum integration, scheduling, and industry relations	1
Primary	Teaching Factory Coordinator	Explaining the management of the Teaching Factory and its connection to learning activities	1
Primary	Entrepreneurship Teacher	Explaining the design of entrepreneurship learning	1

Primary	Productive Subject Teacher	Explaining learning practices, production processes, and work-related skills	1
Primary	Business and Industry Partner	Explaining the form of industry/business involvement	1
Primary	Students	Explaining learning experiences, participation, and views on entrepreneurship	2–3
Secondary	School Documents	Supporting and validating interview and observation data	As needed

Informants were selected using purposive sampling, meaning that participants were chosen based on their direct involvement, knowledge, and access to the focus of the study (Campbell et al., 2020). This technique was used to ensure that the data were obtained from individuals who had a clear understanding of school policy, the implementation of entrepreneurship learning, collaboration with business and industry, and students' learning experiences. In practice, the number of informants could be expanded to a limited extent if further in-depth data were needed.

Data were collected through observation, semi-structured interviews, and document analysis (Berndtsson, 2013). Observation was conducted to directly examine learning situations, teacher-student interactions, students' involvement in production or service processes, the use of tools and work procedures, the involvement of business and industry partners, and entrepreneurial elements emerging in learning practice. The focus of field observations is presented in Table 3. Semi-structured interviews were employed to provide the researchers with a clear direction for questioning while still allowing informants to describe their experiences openly (DeJonckheere & Vaughn, 2019). The interview guide for each type of informant is presented in Table 4. Document analysis was undertaken to examine written and visual evidence relevant to the implementation of Teaching Factory-based entrepreneurship learning (Jing et al., 2023). The types of documents reviewed are presented in Table 5.

Table 3. Focus of Field Observation and Operational Indicators

Observed Aspect	Operational Indicators
Learning Planning	Alignment between learning objectives and practical as well as entrepreneurial activities
Learning Implementation	Teacher activities, student activities, methods, workflow, and task distribution
Teaching Factory Environment	Condition of workshops/laboratories/production units, tools, materials, product displays, and service flow
DUDI Involvement	Presence of partners, provision of work standards, evaluation, guidance, or mentoring
Student Experience	Participation, initiative, collaboration, discipline, creativity, and responsibility
Entrepreneurial Elements	Production, packaging, promotion, service, simple record-keeping, and sales
Field Constraints	Limitations in tools, time, materials, coordination, or partner participation

Table 4. Focus of Semi-Structured Interview Questions by Informant

Informant	Main Focus of Questions

Principal	School policy, support for the Teaching Factory, and the direction of collaboration with business and industry
Vice Principal for Curriculum	Curriculum integration, scheduling, external collaboration, and learning synchronization
Teaching Factory Coordinator	Forms of Teaching Factory implementation, activity management, targets, evaluation, and constraints
Entrepreneurship Teacher	Content, strategies, methods, assessment, and learning outcomes in entrepreneurship education
Productive Subject Teacher	Implementation of practice, work standards, theory-practice integration, and work culture
Business and Industry Partner	Forms of collaboration, contributions to learning, and assessment of students
Students	Experiences in participating in learning, skills acquired, entrepreneurial interest, and self-confidence

Table 5. Types of Documents Reviewed and Their Functions in the Study

Type of Document	Function in the Study
School Profile	To understand the general characteristics of the research site
Curriculum/Teaching Materials	To identify the position of entrepreneurship within the learning process
MoA Documents with Business and Industry	To identify the forms of formal collaboration
Teaching Factory Activity Schedule and Workflow	To understand the rhythm and intensity of implementation
Teaching Factory Management Structure	To identify the actors involved and the division of roles
Activity/Production Reports	To examine evidence of implementation and activity outcomes
Photo/Video Documentation	To strengthen visual evidence of implementation in the field
Promotional/Sales Media	To trace the entrepreneurial aspects being carried out

In this study, the researcher served as the primary instrument, playing a central role in determining the focus, entering the field, interacting with informants, conducting observations, asking questions, selecting documents, and interpreting the data (Chand, 2025). To maintain direction in the data collection process, several supporting instruments were used, including observation guidelines, semi-structured interview guides, document review sheets, field notes, audio recorders, and data matrices. The functions of each instrument are shown in Table 6.

A reflexive stance was maintained throughout the research process. The researchers positioned themselves as external academic researchers/lecturers with an interest in vocational education and did not hold managerial authority over the participating SMKs, DUDI partners, or Teaching Factory programmes. This position was clarified to participants before data collection to reduce the possibility that informants would provide answers merely to satisfy institutional expectations. Potential bias arising from the researchers' prior understanding of vocational education and positive expectations toward Teaching Factory-based learning was managed through the use of semi-structured interview protocols, field notes, data triangulation, peer discussion, and repeated checking of interpretations against interview, observation, and document data.

Table 6. Research Instruments and Their Functions

Instrument	Function
Observation Guide	To maintain the focus of observation on learning activities and the Teaching Factory
Interview Guide	To maintain the flow of questions according to the type of informant
Document Review Sheet	To organize written and visual data systematically
Field Notes	To record context, situations, reflections, and spontaneous findings
Audio Recorder	To ensure the accuracy of verbal data during interviews
Data Matrix	To facilitate comparison of findings across schools

Data were analyzed using the Miles, Huberman, and Saldaña model, which includes data condensation, data display, and conclusion drawing/verification (Mulyani & Rostini, 2026). During the data condensation stage, the researchers selected, focused, simplified, and grouped the data according to the research focus. During the data display stage, the grouped data were organized into matrices, thematic narratives, site-by-site summaries, and cross-site comparisons so that patterns emerging from the 16 schools could be clearly identified. Subsequently, conclusion drawing and verification were carried out gradually by rechecking findings through different sources and techniques to ensure that the final conclusions were grounded in robust data. The flow of data analysis is presented in Table 7.

Table 7. Stages of Data Analysis and Their Activities

Stage	Activities
Data Condensation	Selecting, coding, grouping, and focusing the data
Data Display	Developing matrices, thematic narratives, and cross-site comparisons
Verification	Checking data consistency through triangulation and repeated review
Final Conclusion	Formulating the core findings on Teaching Factory-based entrepreneurship learning

Trustworthiness was maintained through source triangulation, technique triangulation, member checking, prolonged observation, and an audit trail (Ahmed, 2024). Source triangulation was carried out by comparing information obtained from principals, teachers, Teaching Factory coordinators, business and industry partners, students, and school documents (Manouilidou, 2024). Technique triangulation was conducted by comparing findings from observation, interviews, and documentation (Natow, 2020). Member checking was undertaken by asking informants to confirm summaries of interview results or particular findings (Iivari, 2018). Prolonged observation was conducted through sufficiently intensive observation at each research site (Dado et al., 2023). Meanwhile, the audit trail was maintained by preserving field notes, interview transcripts, documents, and analysis matrices as a basis for ensuring the traceability of the research process (Carcary, 2020).

RESULTS AND DISSCUSION

Results

Based on observations, interviews, and document analysis conducted in 16 vocational high schools in South Sumatra, it was found that Teaching Factory-based entrepreneurship learning was implemented in different ways across schools. These variations were reflected in school policy, the readiness of the Teaching Factory unit, the forms of business and industry involvement, and the learning experiences gained by students

during the learning process. In some schools, the implementation had been supported by clear policies, activity management, and partner involvement. In other schools, however, it remained more limited to production or service practice conducted within the school environment.

General Patterns of SMK-DUDI Collaboration Based on the Teaching Factory

Cross-site findings show that SMK-DUDI collaboration based on the Teaching Factory generally took three forms. First, collaboration at the policy and institutional level, reflected in principal support, the formal establishment of the Teaching Factory program, and its alignment with the school curriculum. Second, collaboration at the operational learning level, reflected in the involvement of productive subject teachers, entrepreneurship teachers, and Teaching Factory coordinators in organizing practice, production, service activities, and evaluation. Third, collaboration at the external partner level, in which business and industry partners were involved through the provision of work standards, product input, technical mentoring, or market networking opportunities. This was illustrated by one principal, who explained:

> *"Our Teaching Factory does not stand alone. It is embedded in the school's policy direction, so productive teachers, entrepreneurship teachers, and the industrial relations unit work together to ensure that student activities are not limited to practice, but are also connected to entrepreneurship learning."(Principal)*

A similar view was expressed by a business and industry partner:

> "We do not merely accept students for learning; we also provide input on work standards, product quality, and service procedures so that students can understand what the real work environment looks like."*(Business and Industry Partner)*

The depth of collaboration varied across schools. In some schools, DUDI was involved from the planning stage through implementation to the evaluation of student work outcomes. In others, DUDI involvement appeared mainly in the form of formal agreements, the provision of practice placements, or occasional communication. These differences were evident in the variation of collaboration documents, the intensity of interaction with partners, and the form of DUDI presence in learning activities. A summary of the cross-site finding patterns is presented in Table 8 and re-visualized in Figure 1.

Table 8. Summary of Cross-Site Findings

Dimension of Findings	Cross-Site Tendencies	Educational Meaning
School policy	Most schools had positioned the Teaching Factory as part of strengthening vocational learning	The Teaching Factory gained institutional legitimacy and implementation space
Teacher roles	Productive subject teachers were more dominant in technical aspects, while entrepreneurship teachers strengthened entrepreneurial reflection	Learning became more holistic when both roles were interconnected
DUDI involvement	The level of involvement ranged from consultative to participatory	The quality of collaboration affected how closely learning was linked to industrial situations
Student experience	Students were more active in real activities than in theoretical entrepreneurship learning	Direct experience became an entry point for the development of entrepreneurial attitudes

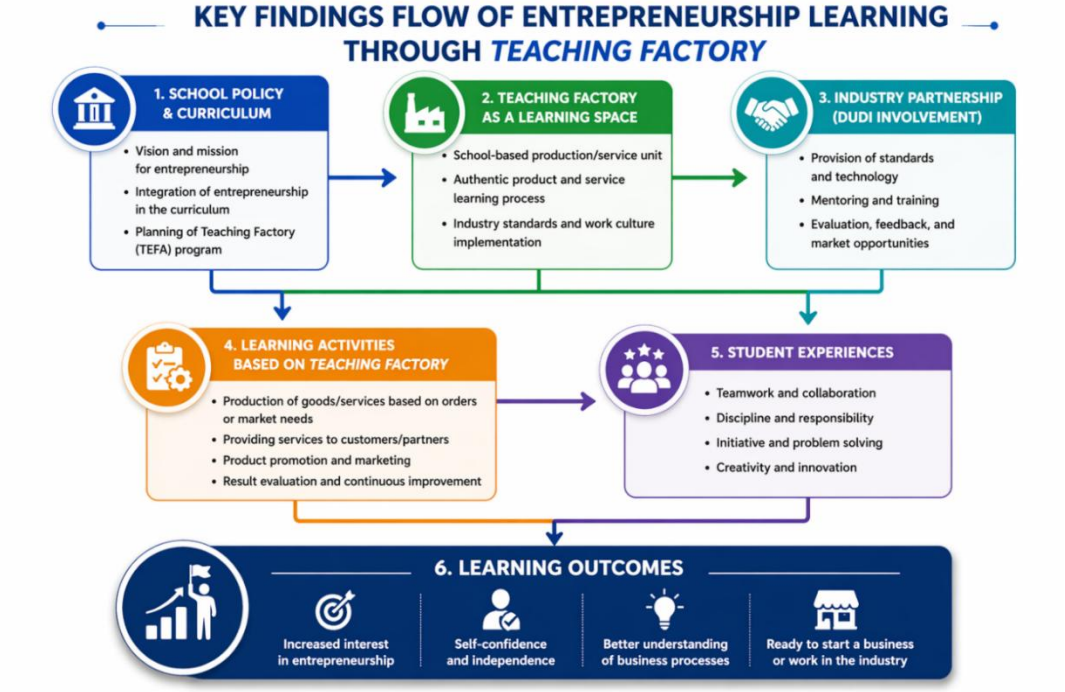

Figure 1. Flow of main findings of entrepreneurship learning based on Teaching Factory

The Implementation of Entrepreneurship Learning in the Context of the Teaching Factory

Across all sites, entrepreneurship learning was not found to operate as an activity fully separate from practical work. In various schools, entrepreneurial elements emerged alongside the production of goods or services, task distribution, the fulfillment of quality standards, service delivery, packaging, promotion, and evaluation of work outcomes. Thus, the observed learning activities were not limited to classroom-based instruction, but also involved students' direct participation in work processes carried out within the Teaching Factory unit.

This condition was described by one entrepreneurship teacher as follows:

> *"In the classroom, students learn the basic concepts of business, but in the Teaching Factory they learn directly how products are made, how customers are served, and how work outcomes are evaluated."(Entrepreneurship Teacher)*

A productive subject teacher also described the integration of learning with practice:

> *"In production activities, we do not only teach students technical procedures, but also how to divide tasks, maintain quality, and complete work according to targets." (Productive Subject Teacher)*

Observations also showed that students were involved in various stages of activity, such as preparing materials, following workflow procedures, completing tasks according to assigned roles, interacting with service users, and reviewing work outcomes. One student described the experience as follows:

> *"At first I thought it was just ordinary practice, but it turned out that we were also learning how to serve customers, explain products, and improve the results when they were not yet appropriate."(Student)*

Interview data from teachers and Teaching Factory managers indicated that entrepreneurship learning was more often linked to practice-based activities conducted directly in production or service units. The form

of the relationship between learning activities and student experiences is summarized in Table 9 and visualized in Figure 2.

Table 9. Relationship Between Learning Activities, Student Experiences, and Entrepreneurial Implications

Learning Activities	Forms of Student Experience	Entrepreneurial Implications
Production of goods/services	Students learned to follow quality standards, time targets, and task distribution	Developed work discipline and responsibility
Service and communication	Students interacted with customers or service users	Increased self-confidence and communication skills
Packaging and promotion	Students learned to present the selling value of products/services	Fostered market awareness and creativity
Evaluation of work outcomes	Students compared results with expected standards	Encouraged quality reflection and continuous improvement

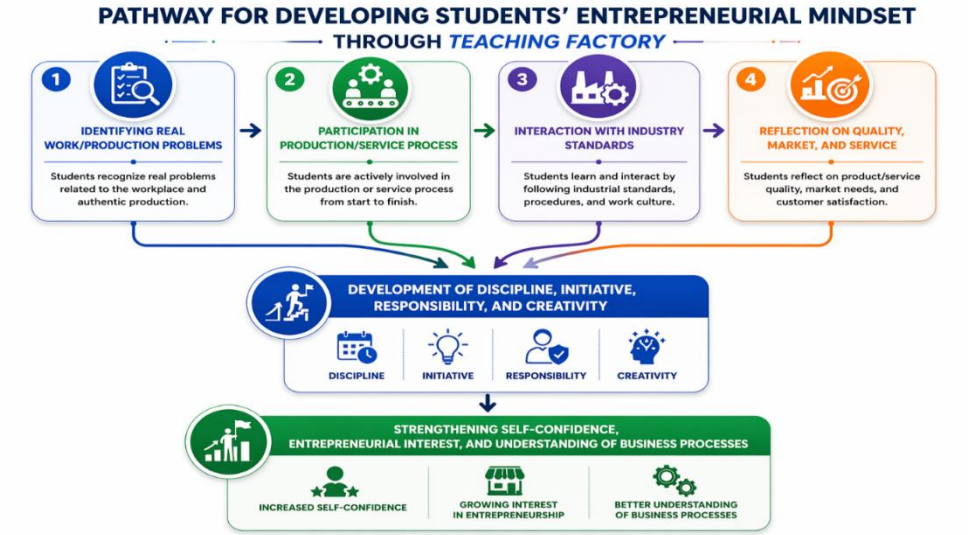

Figure 2. Trajectory of student entrepreneurial development through Teaching Factory

The Role of DUDI in Strengthening Students' Learning Experiences

The role of DUDI identified in this study was found along a broad spectrum. In some schools, DUDI was actively involved through the provision of work standards, input on product quality, technical mentoring, and marketing support. In other schools, however, DUDI involvement remained more limited, for example in the form of signing cooperation agreements, communicating at certain times, or providing support that had not yet entered daily learning processes directly. One business and industry partner explained this involvement as follows:

> *"We usually provide input on students' work outcomes, especially in terms of quality and service. Sometimes we also remind the school when the products being developed are not yet aligned with market needs."(Business and Industry Partner)*

Meanwhile, a Teaching Factory coordinator described the variation in school-partner relationships as follows:

> *"Some partners actively monitor and provide guidance, but others are still involved only administratively, so they have not yet entered day-to-day learning activities." (Teaching Factory Coordinator)*

These variations were visible in the differences in joint activities, the intensity of communication, and the types of support provided by partners in each school. Interview data showed that schools with more active relationships with DUDI generally involved partners in setting work standards, providing feedback on students' work outcomes, or participating in mentoring activities. In schools where partnership relations were less intensive, DUDI involvement tended to remain at the administrative level and was not directly connected to the daily implementation of learning activities.

The Impact of Learning on Students' Entrepreneurial Orientation

Overall, cross-site data indicated visible changes in students during their participation in Teaching Factory-based entrepreneurship learning. These changes were reflected in students' discipline in meeting work targets, responsibility for assigned tasks, willingness to take initiative, ability to work collaboratively, and self-confidence while participating in production and service activities. One student described the change experienced as follows:

> *"Before joining this activity, I was not confident speaking, especially when I had to explain something to others. After being involved more often in service activities, I became more confident."(Student)*

A productive subject teacher also observed changes in student behavior:

> *"What stands out most is their discipline and responsibility. Students are beginning to realize that their work must be completed on time and that the outcomes must meet standards."(Productive Subject Teacher)*

These findings emerged from observations of students' activities, interviews with teachers and Teaching Factory managers, and students' own explanations of their learning experiences. At several sites, students reported that their involvement in production processes, service delivery, and problem-solving had made them more accustomed to real work situations. Teachers also reported changes in the way students carried out tasks, communicated within teams, and presented work outcomes. A summary of the impact of Teaching Factory learning on students' entrepreneurial orientation is presented in Table 10.

Table 10. Impact of Teaching Factory Learning on Students' Entrepreneurial Orientation

Strengthened Aspect	Indication of Findings	Meaning for Learning
Discipline and responsibility	Students became accustomed to following work targets, schedules, and quality standards	Encouraged both work readiness and readiness for entrepreneurship
Initiative and creativity	Students learned to propose ideas, adapt products, and solve problems	Fostered the courage to make decisions
Communication and collaboration	Students learned to interact within teams and with service users	Strengthened entrepreneurial soft skills
Self-confidence and business orientation	Students became more willing to present work outcomes and identify market opportunities	Provided a foundation for the growth of entrepreneurial interest

Supporting and Inhibiting Factors

Cross-site analysis showed that the implementation of Teaching Factory-based entrepreneurship learning was supported by several factors, namely principals' commitment, collaboration among teachers, the availability of active production or service units, and DUDI involvement. These factors appeared in the form of school policy support, role distribution among managers, the availability of practical facilities, and collaborative activities with partners. One principal described this support as follows:

"If a program like this is to work, the school must fully support it. It is not just a matter of permission, but also of preparing schedules, task distribution, and the necessary facilities." *(Principal)*

In certain schools, such internal and external support appeared to be more organized in the learning process. On the other hand, this study also identified several constraints, including limited tools and materials, uneven DUDI involvement, unstable practice schedules, and the view among some students that the Teaching Factory experience was primarily a form of work practice. A Teaching Factory coordinator explained these constraints as follows:

"The challenges we often face are that tools and materials are not always sufficient, and practice schedules sometimes clash with other activities. In addition, not all partners can be involved regularly."(Teaching Factory Coordinator)

One student also stated:

"Sometimes we are already very enthusiastic, but the practice does not always run smoothly because the tools have to be shared and the available time is limited." (Student)

In addition, several schools were found to face administrative and evaluative constraints in Teaching Factory management. A synthesis of the supporting and inhibiting factors was presented in Figure 3 in the original manuscript.

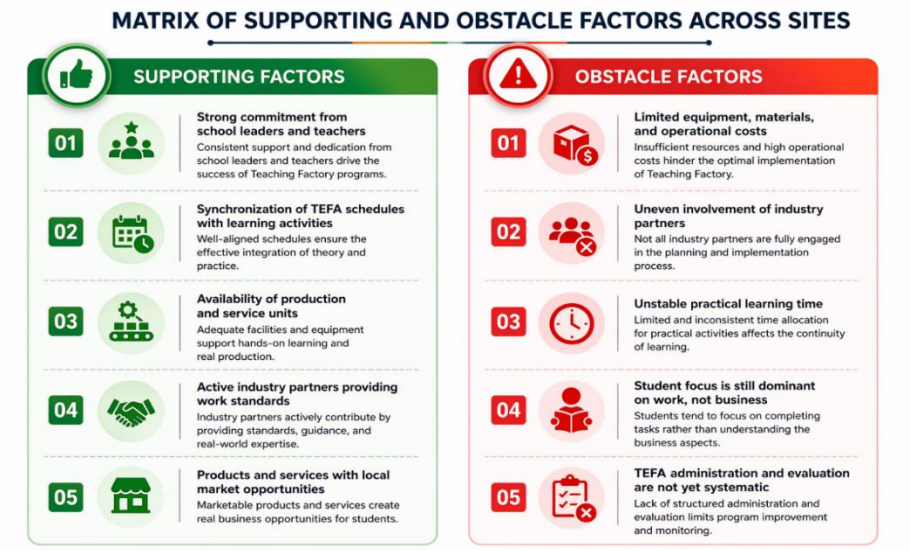

Figure 3. Cross-site supporting and inhibiting factor matrix

Discussion

These findings extend previous discussions on entrepreneurship learning in vocational education by showing that the Teaching Factory should not be understood only as a technical practice unit, but as a learning ecosystem in which entrepreneurial orientation is developed through participation in authentic work processes. Prior studies have emphasized that entrepreneurship learning becomes more effective when students are involved in experiential, project-based, and contextual activities rather than merely receiving classroom-based business knowledge (Nurfadlilawati et al., 2022; Longmore & Grant, 2017). The present study adds a systemic perspective by demonstrating that the entrepreneurial value of the Teaching Factory emerges when school policy, curriculum design, teacher facilitation, DUDI involvement, production or service activities, and

student reflection are connected within one learning process. Theoretically, this finding supports a shift from viewing entrepreneurship education as the transfer of business concepts to viewing it as situated value-creation learning. In this perspective, initiative, responsibility, creativity, self-confidence, and business orientation are not developed only through separate entrepreneurship lessons, but through students' engagement with real tasks, quality standards, customer or partner expectations, task distribution, and problem-solving in situations that approximate the world of work and business. Compared with studies that mainly position the Teaching Factory as a strategy for aligning vocational skills with industrial standards (Kubberød & Pettersen, 2017), this study highlights its broader role as an entrepreneurial learning ecosystem that connects employability, enterprise awareness, and school-industry collaboration.

These findings can be interpreted through the lens of experiential learning, which places direct experience at the center of the learning process (R. Article, 2018). In the context of this study, students not only received explanations about business, but also directly experienced work processes that required active participation, responsibility-taking, and adjustment to particular standards. Such experiences are important because entrepreneurship learning cannot stop at conceptual mastery alone, but requires engagement in real situations capable of shaping students' ways of thinking, attitudes, and responses to opportunities and challenges (Kubberød & Pettersen, 2017). From this perspective, the Teaching Factory is important not merely because it provides facilities for practice, but because it creates a space for learning that moves from experience toward deeper understanding (Chryssolouris et al., 2016).

In addition, the results of this study reinforce the importance of work-based learning in vocational education (Schaap & Baartman, 2012). The variations in practice found across the 16 schools indicate that the strength of learning is determined not only by whether production or service activities exist, but also by the extent to which such activities truly function as an authentic work context. When students learn in an environment that reflects actual work rhythms, quality standards, service demands, and real problem-solving, entrepreneurship learning gains a more concrete foundation (Tan & Ng, 2006). By contrast, when Teaching Factory activities operate merely as technical practice without a clear connection to business logic, their entrepreneurial learning value becomes more limited (Higgins et al., 2013). This suggests that real work is not simply the background of learning, but the main medium through which students develop an understanding of business processes (Seethamraju, 2012).

The findings regarding variation in DUDI involvement are also significant. This study shows that DUDI should not be understood merely as an administrative partner, but as an element that determines the depth of students' learning experiences (Islam et al., 2022). Within the framework of school-industry partnership, meaningful collaboration is not measured solely by the existence of formal cooperation documents, but by the extent to which industry or business partners are present in the learning process, provide standards, offer feedback, and help connect schools with market needs and work culture (Stacho, 2019). In other words, DUDI is important not only because it expands school networks, but because its presence can transform learning from internal simulation into an experience that is closer to external reality (Zulfikar et al., 2024). At this point, the study confirms that the quality of collaboration matters more than the formality of collaboration (Lee et al., 2015).

From the perspective of developing entrepreneurial orientation, the findings indicate that changes in students first appear in the form of discipline, responsibility, initiative, collaboration, and self-confidence before developing into a more mature entrepreneurial orientation (Frunzaru & Cismaru, 2021). This finding is important because it places entrepreneurship learning on a more realistic path (Wasim et al., 2024). At the vocational high school level, the success of entrepreneurship learning does not need to be measured immediately by the emergence of new entrepreneurs after graduation (Hopp & Sonderegger, 2015). A more

reasonable indicator is whether learning has succeeded in forming the initial dispositions that serve as the basis for the growth of entrepreneurial orientation, such as the courage to take on roles, the ability to recognize user needs, and the willingness to improve work outcomes (Wolff et al., 2015). Within the framework of entrepreneurial learning, this process shows that entrepreneurship develops through repeated engagement in value-creating actions rather than through verbal motivation or the delivery of conceptual material alone (Jones et al., 2020).

Accordingly, Teaching Factory-based entrepreneurship learning in this study is more appropriately understood as a process of orientation formation rather than merely knowledge transfer (Jing et al., 2023). When students engage in production, service, packaging, promotion, and evaluation of outcomes, they do not simply learn how to perform tasks; they also learn to understand the relationship between quality, customers, processes, and results. This relationship lies at the core of entrepreneurship learning (Rae, 2017). In this sense, students begin to recognize that business is not merely about selling something, but about maintaining quality, recognizing needs, providing service, and making continuous improvements (Matulich et al., 2015). From an academic perspective, these findings broaden the way the Teaching Factory is understood, moving from a model of practice-based vocational learning to a space for entrepreneurship learning that integrates technical, social, and market dimensions simultaneously (Schwede et al., 2025).

The findings regarding supporting and inhibiting factors are also meaningful for the development of vocational education. Principal support, teacher collaboration, the availability of production or service units, and DUDI involvement indicate that strong entrepreneurship learning emerges from the intersection of internal school support and external partner support (Marra, 2025). This means that the success of the Teaching Factory cannot be placed solely on teachers or solely on facilities (Chryssolouris et al., 2016). It requires consistent institutional management, a clear division of roles, and dynamic partnership relations. Conversely, constraints such as limited tools and materials, uneven DUDI involvement, unstable practice schedules, and weak administrative management indicate that the primary challenge of implementation lies not in the idea of the Teaching Factory itself, but in schools' ability to sustain the supporting system over time.

When placed within the context of previous studies, this research offers a different emphasis. A number of earlier studies have generally positioned the Teaching Factory as a means of enhancing vocational skills or work readiness (Prianto, 2021). Other studies have highlighted entrepreneurship as a competency that should be developed in vocational education, while research on SMK-DUDI relations has mostly focused on institutional partnerships or curriculum relevance (Kasanah et al., 2025). This study shows that the strength of entrepreneurship learning actually lies at the intersection of all these elements. In other words, the main contribution of this study is to affirm that the Teaching Factory should be read as an entrepreneurial learning ecosystem grounded in the interconnectedness of school policy, authentic work contexts, partner involvement, and students' learning experiences. It is at this point that the study moves beyond perspectives that see the Teaching Factory only as a place for production practice (Chryssolouris et al., 2016).

The practical implications of these findings are quite clear. If schools seek to strengthen entrepreneurship learning, the Teaching Factory should be positioned as the core of learning rather than merely a complement to technical competence (Malik, 2018). Entrepreneurship teachers and productive subject teachers need to work in a more integrated manner so that students do not separate work practice from business logic (Ruskovaara & Pihkala, 2013). DUDI involvement also needs to be directed toward more substantive functions, such as setting standards, providing feedback, and strengthening market orientation. In addition, learning evaluation should not be limited to technical outcomes, but should also consider responsibility, initiative, communication, collaboration, and the way students understand the relationship

between work processes and business value. With such a direction, the Teaching Factory can develop as a learning space that not only prepares students for employment, but also helps them build a foundation for entrepreneurship (Malik, 2018).

Overall, this discussion confirms that Teaching Factory-based entrepreneurship learning becomes strong when schools succeed in transforming practical activities into meaningful learning experiences. Such strength does not lie solely in facilities, but in the ability of schools and partners to bring work experiences and business experiences into everyday learning processes. Therefore, the main value of the Teaching Factory in this study lies not only in its role as a model of vocational practice, but also in its function as a space for shaping students' entrepreneurial orientation through direct experience, authentic work contexts, dynamic partnerships, and repeated learning processes.

CONCLUSION

This study shows that entrepreneurship learning among vocational high school students through Teaching Factory-based collaboration between schools and business and industry is most appropriately understood not as mere production practice, but as a learning system that connects school policy, curriculum, teacher roles, partner involvement, and students' learning experiences within authentic work context. The novelty of this article lies in its emphasis that the Teaching Factory constitutes an entrepreneurial learning ecosystem that not only strengthens technical skills, but also develops students' discipline, responsibility, initiative, collaboration, self-confidence, and entrepreneurial orientation. The findings also reveal that the success of learning is strongly influenced by the quality of school-DUDI partnerships, principal support, collaboration among teachers, and the availability of active production or service units, while limited facilities, uneven DUDI involvement, unstable practice schedules, and weak administrative management remain the main obstacles. Therefore, in practical terms, the Teaching Factory should be positioned as the core of entrepreneurship learning in vocational high schools through stronger integration among entrepreneurship teachers, productive subject teachers, and DUDI partners, as well as evaluation systems that assess not only technical outcomes but also the development of students' attitudes and entrepreneurial orientation. Although this study is limited to 16 vocational high schools in South Sumatra and is not intended for statistical generalization, its findings open opportunities for future research to develop more structured Teaching Factory implementation models, compare practices across regions, and examine more broadly the relationship between SMK-DUDI collaboration, learning experiences, and the strengthening of students' entrepreneurial orientation.

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