Jurnal Pendidikan Vokasi
Volume 14, No. 2, 2024, pp. 133-146
Online: https://journal.uny.ac.id/index.php/jpv

Increasing creativity, production innovation and commercialization through the new teaching factory model based on life skills

Cucu Sutianah [1] *, Bandi Sobandi [1], Alfian Azhar Yamin [1], Phan Doang Kieu Trang [2]
[1] Universitas Pendidikan Indonesia, Indonesia.
[2] University of Southampton, United Kingdom.
* Corresponding Author. Email: cucu.sutianah@upi.edu

ARTICLE INFO

Article History
Received:
November 11, 2023;
Revised:
March 28 2024;
Accepted:
August 22, 2024;

Keywords
Commercialization;
Ceative craft design;
Innovation in vocational education;
Production;
Quasi-experimental design;
Teaching and learning factory

ABSTRACT

This research aims to implement and develop a new teaching and learning factory model based on life skills in Vocational Secondary Education (SME) Creative and Production Crafts Expertise Program. This model is designed to support the needs of the Industrial Revolution 4.0 by integrating project-based learning through collaboration between the school curriculum and the industrial world. This research usesmixed methods, with a quasi-experimental design involving control and experimental groups using pre-test and post-test. The results showed that the new teaching and learning factory model was valid and reliable based on expert validation tests. The implementation of this model successfully increased students' creativity in product design, production, and commercialisation, and it developed social skills such as critical thinking, communication, collaboration, and interpersonal skills. In conclusion, the implementation of the life skills-based teaching factory model is effective in preparing students to face the challenges of the world of work, improving innovation skills, and supporting production processes that are relevant to industry needs. The contribution of this research is in the development of an innovative learning model that integrates the education curriculum with the world of work, thus producing graduates who are better prepared to face the challenges of the Industrial Revolution 4.0..

INTRODUCTION

Graduates of vocational schools must possess noble thoughts and morals through education while fostering creativity, innovation, sportsmanship, and an entrepreneurial spirit. The learning process must support the development of the creative economy and creative industries by focusing on national economic activities rooted in students' creativity, skills, and talents. This aims to generate innovative power and individual creativity with economic and market value, thereby influencing the welfare of Indonesian society. Previous research has shown that vocational education can enhance students' technical skills when designed with contextual and industry-practice-based learning models. Vocational education, when designed contextually, integrates real-world experiences and industry standards into the curriculum, creating a more relevant and effective learning environment for students (Setyowati et al., 2020).

Furthermore, the success of industry-based learning models, such as workplace learning, in facilitating the absorption of both tacit and explicit knowledge in industrial settings is a cause for optimism. By providing practical guides for teachers and students, this model enables students to better understand how theoretical concepts are applied in real-world practices (Rahmawati, 2024). The positive outcomes in enhancing students' problem-solving skills, with reported learning efficiency levels exceeding 80%, are a testament to the potential of vocational education (Alongkrontuksin et al., 2024).

Moreover, experiential approaches in vocational education have a significant impact. For example, industrial-class-based learning has been shown to increase student motivation while strengthening their practical skills, effectively bridging the gap between vocational education and workforce needs (Fania et al., 2024). Direct training and learning within industries, known as Learning and Training Within Industry (LTWI), have demonstrated a positive influence on students' work readiness, with its effectiveness categorized as "very good" based on evaluations of the model's implementation outcomes (Sudarsono et al., 2024).

In the modern era, the integration of informatics into vocational education has become a crucial aspect that cannot be overlooked. The application of informatics technology allows students to develop technical and cognitive skills through hands-on experiences with advanced technologies, preparing them to meet the demands of an increasingly dynamic workforce (Fitrihana & Nurdiyanto, 2023). Thus, informatics integration not only enhances the quality of learning outcomes but also supports the relevance of vocational education to the Industry 4.0 revolution.

In this context, teaching factory-based learning emerges as a highly significant strategy to bridge students with industrial realities. Teaching factories not only prepare students to face workforce challenges but also encourage the development of skills in innovation, creativity, and product commercialization that align with the needs of modern industries. This approach combines contextual, experiential, and technological aspects into vocational education, providing a strong foundation for producing graduates who are more competitive in the global labor market. Consequently, vocational education can transform into one of the main pillars of high-quality human resource development.

In the 21st century, the role of Vocational High School (VHS) in addressing the challenges of the modern workforce is crucial. This education is not just about producing graduates who are ready for employment, but also about equipping them with the skills for innovation and competition in the era of Industry 4.0. Integrating 21st-century skills, such as communication, collaboration, and critical thinking, is essential to ensure vocational education aligns with the needs of modern industries. Partnerships with industry are a key element in bridging this gap, enabling curriculum alignment with industrial standards through initiatives such as teacher apprenticeships, guest lectures by industry professionals, and infrastructure support (Soleh et al., 2023). However, challenges such as unclear program objectives and a lack of trust from industries often hinder the success of these initiatives. Additionally, entrepreneurial education is essential to address common barriers faced by vocational school graduates, such as risk aversion and limited resources, which are known as "entrepreneurial blocks" (Haryanto et al., 2022). This research aims to provide integrated solutions to these issues, enabling graduates not only to meet workforce demands but also to start their businesses independently, creating innovative and relevant new job opportunities.

The development of 21st-century skills, such as collaboration and critical thinking, plays a vital role in enhancing the job readiness and entrepreneurial capabilities of vocational school graduates (Putra et al., 2021). Vocational education must also adapt to the changing global labor market to produce competent, innovative, and highly competitive graduates (Nurmalasari et al., 2019). Another pressing need is for new learning models that effectively integrate education with real-world work environments, creating a sustainable synergy between educational institutions and industrial needs. In this context, traditional academic pathways can complement vocational approaches to create a holistic framework that meets the diverse needs of students. By developing life-skills-based learning models, this research contributes significantly to improving the relevance and quality of vocational education, aiming to produce graduates who are not only job-ready but also highly skilled, globally competitive, and capable of leading meaningful and productive lives.

The empowerment of processes and outcomes in vocational hihg school education must be implemented continuously with high quality to meet the needs of students and the workforce, encompassing industrial, business, MSME sectors, as well as government and private institutions. This continuous improvement effort aims to produce graduates with entrepreneurial skills and competencies through collaborative development with industries and various business entities in the form of industrial learning, known as the teaching industry. The teaching factory model has proven effective in enhancing students' vocational abilities, particularly in the areas of technology-based production skills and innovation (Amar et al., 2016). Moreover, collaboration with the industrial

sector can increase the relevance of education to the constantly evolving labor market demands, motivating the audience to contribute to the ongoing development of vocational education.

The implementation of teaching factories in VHS's has become a crucial strategy to bridge the gap between educational practices and industrial needs. This approach facilitates collaboration between educational institutions and the workforce to ensure that curricula align with real-world demands (Rudiyanto, 2024). It supports project-based learning that provides students with hands-on experience in modern industrial practices while simultaneously enhancing life skills such as critical thinking, communication, and collaboration, which are essential for job readiness. Furthermore, research indicates that this model significantly boosts students' creativity and innovation, particularly in product design and commercialization (Sulistyowati et al., 2024) . In terms of effectiveness, the teaching factory model has been validated to improve learning outcomes and student engagement, demonstrating its reliability in enhancing the quality of vocational education (Hatmojo & Ikhsannudin, 2024). However, challenges remain in fully integrating this model across all institutions, necessitating further research to explore innovative applications and address potential barriers to its implementation.

These challenges have driven researchers to develop a teaching factory and life-skills-based learning model aimed at fostering creativity and innovation in the design, production, and commercialization of vocational high school creative crafts. This model seeks to cultivate entrepreneurial character, work ethics, communication skills, collaboration, as well as social, emotional, academic, and vocational abilities, all of which are encompassed within life skills or real-world competencies. The research aims to develop and implement a life-skills-based teaching factory model to enhance vocational high school students' abilities in creative product design, production innovation, and commercialization. The benefits of this research include the development of a new learning model that can be adopted by vocational high school across Indonesia, contributing to improved graduate quality relevant to the needs of modern industries.

The primary goal of this research is to create an effective learning model that enhances innovation, creativity, and entrepreneurial skills among VHS's students, making them better prepared to face the challenges of Industry 4.0. The main contribution of this research is the development of a close integration between educational curricula and the industrial world to produce high-quality graduates who are competitive in the global job market.

METHOD

This study employs a mixed methods approach, combining quantitative and qualitative methods to obtain comprehensive data on the effectiveness of the life-skills-based learning model in developing creativity, innovation, and entrepreneurship among vocational high school students. This approach enables an in-depth exploration through qualitative descriptions while testing relationships and differences through quantitative analysis (Creswell & Clark, 2017). The research was conducted at SMK Negeri 14 Bandung City during the odd semester of the 2023/2024 academic year, focusing on the Craft Product Design and Visual Communication Design Expertise Programs.

The research design employed is a robust quasi-experimental design with a pretest-posttest control group model. This design, meticulously planned and executed, involved the random selection of two groups of students: an experimental group and a control group. The experimental group received an intervention involving the implementation of the life-skills-based learning model within a teaching factory, while the control group followed conventional teaching methods (Campbell & Stanley, 2015). A pretest was conducted before the intervention to measure the student's initial skill levels, and a posttest was conducted after the intervention to evaluate the effectiveness of the applied learning model.

The population of this study consisted of Grade XII students in the Craft Product Design and Visual Communication Design Expertise Programs. The sample was selected using a simple random sampling technique, with a total of 50 students divided into two groups: 25 students in the experimental group and 25 students in the control group. Additionally, the study involved teachers and school management staff as qualitative data sources, fostering a collaborative research

environment and providing an in-depth perspective on the implementation and challenges of applying the life-skills-based learning model.

Quantitative data were collected using standardized tests to measure students' creativity, innovation, and critical thinking skills. The validity and reliability of the instruments were tested using Pearson Product Moment correlation and Cronbach Alpha reliability coefficients (Taber, 2018). The instruments were deemed valid if the correlation coefficient exceeded 0.3 and reliability exceeded 0.7. Qualitative data were obtained through structured interviews with students, teachers, and school leaders, as well as non-participant observation of the teaching model implementation in the experimental class.

Quantitative data analysis was performed using SPSS version 21. The data were analyzed using paired sample t-tests to test the significance of the differences between pretest and posttest scores in the experimental group. For qualitative data, thematic analysis was employed, allowing researchers to identify key themes from interviews and observations and relate them to the research objectives (Braun & Clarke, 2006). This study aims to evaluate the extent to which the implementation of the life-skills-based learning model in a teaching factory can enhance student competencies while identifying supporting and inhibiting factors in its implementation. The findings, with their practical implications, are expected to contribute significantly to the development of vocational education policies and practices that align with industry needs and the era of the Industrial Revolution 4.0.

RESULTS AND DISCUSSION

The implementation of collaborative learning involves students working together and solving problems collectively rather than individually. This process demonstrates students' intelligence distribution during the learning process, where each student contributes according to their abilities. Collaborative learning focuses on group work and emphasizes comprehensive and fair communication within the classroom (Sutianah et al., 2023). The establishment of clear group work rules and criteria, often designed by the students themselves, ensures fairness and individual accountability within the group. This approach plays a crucial role in reducing social loafing among group members, reassuring educators about the effectiveness of collaborative learning. It also promotes equitable task distribution, creating an inclusive learning environment (Kramer, 2024). Students' ability to establish group work rules reflects their understanding of effective collaboration principles, forming the foundation of fair communication during the learning process (Kramer, 2024).

Furthermore, the collaborative learning process not only fosters creativity but also significantly develops students' social skills. By encouraging positive interaction among group members, collaborative learning increases students' preference for group work over individual tasks, fostering a sense of community and personal growth. This approach also incorporates multidisciplinary knowledge or metacognition, connecting various fields across subjects to produce goods, services, or appropriate technologies relevant to students' future lives. Research indicates that creativity is influenced by 77.9% and critical thinking by 27.1% through the collaborative approach (Nisa et al., 2023). By integrating effective communication, fairness, and cooperation, collaborative learning enriches students' learning experiences and provides a strong foundation for developing interpersonal and cognitive skills relevant to the challenges of 21st-century education.

Teachers act as communicators, collaborators, facilitators, consultants, assessors, problem solvers, creators, and innovators who provide support but do not interfere with the group achieving the predetermined outcomes. Students are free to take responsibility for their learning outcomes and seek information to answer the questions they face. The collaborative teaching and learning process encompasses social skills and learning abilities, integrating three key concepts: individual accountability, group benefits, and equitable achievement of success. Collaborative learning aims to enhance student interaction with educators in understanding a task, allowing students to explore their ideas. In detail, the collaborative learning model is described as follows: when collaboration is implemented, all students will be active. Students will naturally communicate with each other in groups. This fosters good relationships and mutual respect because group work is not an individual

task but a collective one. Such conditions encourage cooperation. The educator's role is to observe and assess how students work and communicate while acting as a reference when students need assistance (Sutianah et al., 2023).

The development of life skills for students in general skills that function as personality shapers include: (1) The development of faith, actualized in obedience to Allah SWT, which results in purity; (2) The development of creativity, to fulfill material and intellectual life needs and solve problems faced, resulting in truth; (c) The development of intention, to cultivate an attitude of good behavior (ethics, morals), resulting in goodness; (4) The development of taste, for refined feelings (appreciation of art, perception of art, creation of art), resulting in beauty; (5) The development of work, to make humans skilled and technologically competent, resulting in usefulness; and (6) The development of conscience that functions to provide considerations (faith, creativity, intention, taste, work), resulting in wisdom. The curriculum and learning process cannot be achieved solely through the value of a single subject; competencies must be measured as competent or not yet competent. A combination of knowledge values, technical skills (hard skills), and soft skills values must be fulfilled by students to meet the work competencies required by society.

21st-century education, along with its learning and assessment processes, must shift its focus to concrete competencies. It's not just about scores in each subject, but a multidisciplinary combination manifested in the form of goods and services or appropriate technologies, as well as student competencies. Learning outcomes must result in new competencies needed by stakeholders, leading to the achievement of lifelong learning. This shift in focus prepares students for the challenges and opportunities of the future, ensuring they are equipped with the necessary skills and knowledge.

Table 1. Summary of Aspects of Collaborative Learning and Life Skills Education

Aspect	Description
Collaborative Learning	1. Involves students working together to solve problems, with an equitable distribution of intelligence among students. 2. Emphasizes fair and comprehensive communication in the classroom. 3. Teachers act as facilitators, consultants, and observers without directly intervening. 4. Combines individual accountability, group benefits, and collective achievement of success.
Outcomes and Impacts of Collaboration	1. Enhances creativity through communication, critical thinking, and collaboration. 2. Fosters positive relationships and mutual respect among students. 3. Enables students to take responsibility for their learning outcomes and actively seek information. 4. Supports teamwork for collective tasks.
Life Skills Development	1. Includes the development of faith, creativity, intention, appreciation, work ethic, and conscience to shape student character. 2. Emphasizes a combination of knowledge, hard skills, and soft skills to meet work competency requirements. 3. Learning must be based on concrete competencies, not merely subject grades.
21st-Century Education	1. Integrates multidisciplinary knowledge to produce goods, services, or appropriate technologies. 2. Aligns learning with stakeholder needs and real-life applications.
Interactive and Participatory Methods	1. Life skills education is based on interactive teaching methods focused on real-life situations. 2. Aims to address issues such as substance use, unhealthy behavior, and physical inactivity.
Impacts of Life Skills Education	1. Helps students make healthy life choices and prevents chronic diseases. 2. Improves physical, psychological, and social well-being.

Life skills education, based on interactive and participatory teaching and learning methods (Nasheeda et al., 2019; World Health Organization, 2003), takes a holistic approach to health. It focuses on real-life situations to apply and practice essential skills, often related to problematic attitudes and behaviors such as substance use, consumption of high-calorie foods, violence, risky sexual behavior, or physical inactivity. By addressing these issues, life skills education aims to enable healthy lifestyle choices, thereby preventing chronic diseases and adverse social consequences in the long term (MacArthur et al., 2018; Resnick et al., 2012; Sancassiani et al., 2015; Singla et al., 2020). This comprehensive approach reassures about the potential impact of life skills education. Beyond this problem-focused approach, life skills education also targets physical and mental health by promoting physical, psychological, and social well-being (Clark et al., 2020; O'Connor et al., 2018; Sancassiani et al., 2015; Singla et al., 2020).

Life skills education assumes that individuals can change the way they face circumstances in both their inner and outer worlds, as well as how they proactively and reactively address them. Life skills education primarily builds on the developing cognitive abilities of children and adolescents to think critically about the biological, psychological, and social factors that influence health, make conscious decisions related to a healthy lifestyle, self-regulate, and manage social relationships. Thus, life skills education inherently reflects a developmental perspective of the many nonlinear and complex interactions between individuals and their social environments (Immordino-Yang et al., 2019; Sameroff, 2010; Zelazo, 2013). Sutianah et al. (2023) describe and map the life skills of vocational students in Figure 1.

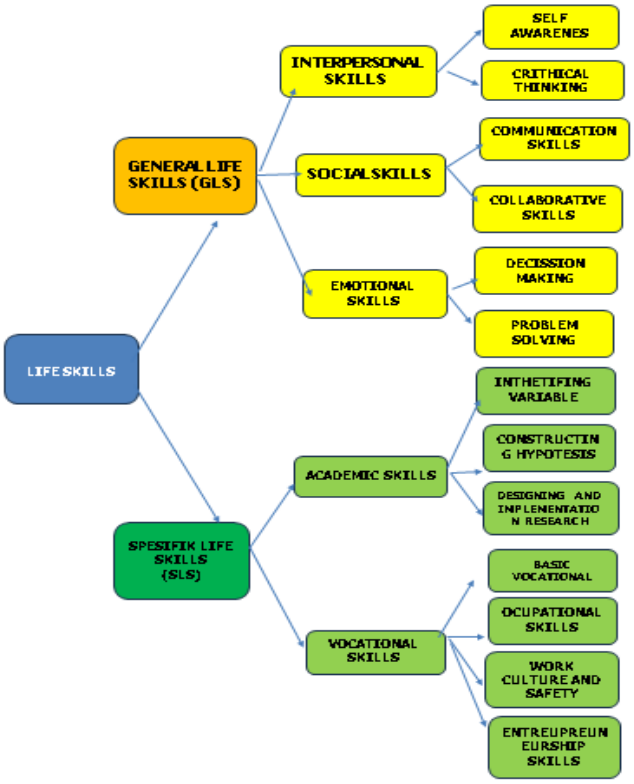

Figure 1. Life Skills of Vocational Student

Learning and assessment based on Higher-Order Thinking Skills (HOTS) are not merely about studying and evaluating knowledge but must also encompass competencies. Thus, there will be questions and solutions that need to be addressed. For instance, how can we ensure that students are equipped with the necessary hard and soft skills to succeed in the 21st century? Is it sufficient to rely solely on midterm and final semester exams at the end of the semester? What about learning and assessments related to these hard and soft skills, which are crucial in real-life scenarios? The most

prominent characteristics of the 21st century include multitasking, multimedia, online social networking, online information searching, and online gaming.

The concept of the learning factory, as defined by Berg et al. (1994), emphasizes the integration of education with the dynamics of the real-world market, where universities operate similarly to businesses to produce and sell goods to customers. A learning factory provides students with a learning experience replicating an industrial manufacturing environment, allowing them to understand real-world practices in producing high-quality products at competitive prices. This model enhances students' technical skills and prepares them to meet industrial demands by focusing on curriculum relevance and student competencies (Rudiyanto, 2024; Szabó et al., 2024). For example, the "Vocafe" model, a collaboration between academia and industry, illustrates how vocational education can be integrated with industrial partners to improve the relevance of education. In this model, students gain practical experience and industry insights, while companies benefit from fresh perspectives and potential future employees. Universities such as Penn State and the University of Washington have adopted the learning factory through collaborative programs with industries, resulting in an increased emphasis on practical engineering design, manufacturing technology, and innovative collaborations (Lamancusa et al., 2008).

The learning factory approach also addresses the skills gap in the workforce by providing hands-on training relevant to industrial needs (Maarof & Bohari, 2023; Milisavljevic-Syed et al., 2023). Learning factories equip students with soft skills and a deeper understanding of technical subjects, making them better prepared to face challenges in the era of Industry 4.0. Moreover, this model not only supports but actively promotes sustainable development by promoting skills-based education that aligns with sustainable economies and emerging technologies (Jing et al., 2023). This inspiring contribution to a better future is a testament to the model's success. However, despite its many advantages, the model faces challenges, such as the need to continuously adapt to evolving industry standards and integrate new technologies. Therefore, balancing educational objectives with market demands remains critical for its success.

The previous explanation emphasized that, as a follow-up to the collaboration that had been established, experimental research was conducted during the period from 1994 to 1996. The research findings revealed several key outcomes: (1) a balance in curriculum implementation that integrated basic technical practices with the theory of manufacturing analysis, design, business realities, social communication, interpersonal communication, and professional skills; (2) the success of manufacturing learning as an integrated collaboration, encompassing experiences in design, manufacturing, and measurable production realities; (3) the establishment of close collaboration with industry based on mutual trust; and (4) productive synergy among educational institutions, government, and industry in addressing the challenges of human resource development.

The teaching factory concept is a pedagogical approach designed to bridge the gap between theoretical knowledge and practical skills, providing hands-on experience that prepares students for real-world challenges. This model integrates learning with the production stages of goods or services, enabling students to gain a more comprehensive understanding of workplace realities (Lamancusa et al., 2008). The teaching factory not only enhances students' technical competencies in areas such as management, marketing, and entrepreneurship but also fosters a spirit of innovation and creativity. For instance, at SMK Negeri 1 Pacet, the implementation of the teaching factory has resulted in superior products meeting industry standards, while at SMK Muhammadiyah Gamping, the model successfully cultivated students' entrepreneurial spirit (Antony et al., 2023; Junaedi et al., 2024). By simulating real-world work environments, the teaching factory ensures that learning goes beyond theory, offering practical experiences that align with labor market demands.

The teaching factory is an educational model that integrates real-world work experience into the vocational school curriculum, preparing students for the workforce by enhancing their technical competencies and entrepreneurial skills. Lamancusa et al. (2008) explain that its fundamental principle involves using equipment, materials, and educational actors to carry out production processes that result in goods or services, providing students with structured work experiences relevant to societal needs. This approach emphasizes learning by doing, where students independently learn through hands-on practice in a simulated industrial environment, deepening their technical expertise (Suhendra et al., 2024).

Furthermore, the teaching factory encourages students to create innovative products and initiate start-ups, fostering creativity and preparing them to become future entrepreneurs (Fitriani, 2024; Patria et al., 2024). Collaboration with communities and industries ensures the curriculum's relevance to real-world demands, with communities acting as markets for student-produced goods, strengthening the relationship between education, industry, and society (Patria et al., 2024). Despite limited resources and insufficient socialization, the teaching factory remains a strategic approach to equipping students with 21st-century competencies.

In vocational secondary schools, the teaching factory serves as an educational model that integrates the production of goods and services into the learning process, enabling students to develop practical skills while producing marketable quality products. This model not only enhances student competencies in areas such as computer engineering, arts, and creative industries (Patria et al., 2024; Suhendra et al., 2024) but also cultivates entrepreneurial spirit through the establishment of start-ups and collaboration with local industries (Junaedi et al., 2024; Mubarak et al., 2020). The goods or services produced by students are designed to meet market needs and be accepted by the community, thereby supporting the financial sustainability of schools and education.

However, implementing the teaching factory faces challenges such as inadequate facilities, limited staff training, and weak regulatory support in some regions (Patria et al., 2024; Suhendra et al., 2024). To maximize its potential, it is crucial to balance practical learning with theoretical knowledge while ensuring stronger regulatory support from the government and greater community involvement.

The teaching and learning factory brings the industrial/real-world work environment into the school setting to prepare either work-ready or self-reliant graduates. Hadlock et al., as cited in Fajaryati (2012), stated that the teaching and learning factory aims to make students aware that learning should go beyond what is contained in books. Students not only practice soft skills during learning, work in teams, and develop interpersonal communication skills but also gain direct experience and work practice to enter the workforce.

The explanation highlights that implementing the teaching and learning factory involves integrated learning, encompassing competency-based, production-based, project-based, and other instructional methods. This learning model includes role-playing, inquiry, discovery, and science-based learning, integrating several subjects from national and regional compulsory curricula, vocational courses, and entrepreneurship programs (PKK) within a prototype curriculum. Through the teaching and learning factory, students can address real societal needs by producing economically valuable goods in line with their area of expertise.

The new teaching factory is an essential and urgent approach in vocational education, designed to enhance skills across various fields, including social sciences, technology, engineering, economics (entrepreneurship), arts, mathematics, and management. It aims to develop life and career skills, provide hands-on training through learning by doing, and offer authentic and contextual learning experiences. This model encourages creative and design thinking, fosters entrepreneurial character, and creates an industrial atmosphere by integrating productive work culture and occupational health and safety (K3) practices.

In vocational schools, the implementation of the teaching factory is categorized into three levels. The first level involves products designed for competency assessment and sustainable production, generating income for the school or representing an upscaled production system. This level reflects established companies equipped with branding, corporate culture, legal status, and employees. The second level introduces start-up companies, which develop branded and legally certified products for competency assessment (CA) and limited-scale production based on specific consumer or industry orders. The third level focuses on prototypes created as learning outcomes, without branding or legal status, representing the initial stages of production and innovation.

The teaching factory operates on five foundational pillars. The first pillar is an actual curriculum aligned with the professional world, including business sectors, industries, MSMEs, government, and private institutions. This curriculum is designed to create relevant projects and establish job roles with clearly defined tasks. The second pillar emphasizes a real environment, ensuring that at least 80% of the equipment and facilities meet industrial standards. This includes

adequate space, maintenance, layout, K3 compliance, electrical capacity, and collaboration with related industries.

The third pillar focuses on product specifications, encompassing applied research, producing marketable goods, digital and online marketing, product certification, legal compliance, and intellectual property registration (IPR). The fourth pillar integrates teaching tools into a project-based learning system, supported by management commitment, human resource development, edupreneurship initiatives, and block-based scheduling. This pillar also includes competency-based modules developed in collaboration with industry and real competency assessments aligned with Indonesian National Work Competency Standards (SKKNI).

Finally, the fifth pillar involves the implementation of industrial cycles within the teaching factory, emphasizing work culture and ethics encapsulated in the 6Rs: clean, careful, diligent, concise, neat, and friendly. These principles guide students in their work, ensuring they develop a professional and respectful attitude towards their tasks and colleagues. Together, these elements create a holistic framework for the teaching factory, bridging the gap between education and the modern demands of industry while equipping students with the skills and competencies required for real-world success.

Table 2. Teaching Factory Pillars

No.	Pillars	Explanation
1	Real Curriculum	Developing a curriculum aligned with the professional world (business sectors, industries, MSMEs, government, and private institutions) that creates projects and at least one job position with several job tasks.
2	Real Environment	Ensuring the relevance of primary and supporting equipment that meets at least 80% of industrial standards, including sufficient space, maintenance, layout, occupational health and safety (K3), electrical capacity, and collaboration with related industries.
3	Product Specifications	Conducting applied research, ensuring product quantity and quality with marketable value, digital and online product marketing, product certification/legal status, and intellectual property registration.
4	Integrated Teaching Tools	Utilizing project-based teaching tools, management commitment, human resource (HR) commitment, edupreneurship, block scheduling systems, HR competencies, learning models and strategies, competency-based learning modules, industry-supplied modules, and real competency assessments based on Indonesian National Work Competency Standards (SKKNI).
5	Industrial Cycle Implementation	Applying work culture and ethics (6Rs: clean, careful, diligent, concise, neat, friendly).

The planning flow of the new teaching factory (TEFA) includes a competency analysis that aligns with the needs of students and the demands of the workforce. This process harmonizes the independent curriculum with the workforce curriculum and analyzes graduate profiles relevant to the skills program. The developed curriculum, which is implementable and industry-based, adheres to the Indonesian National Work Competency Standards (SKKNI). It is designed to produce projects and products that support specific job types and conduct multiple job analyses. The subsequent analysis of market/consumer needs is aimed at addressing real-world problems, determining products, and creating prototypes. The use of the Business Model Canvas (BMC) for designing business models is a strategic move that ensures the program's market relevance. The implementation of teaching factory learning as authentic teaching, learning, and assessment, utilizing a full block scheduling system, further underscores the program's commitment to market relevance. The program concludes with teaching factory-based sustainable business management, which includes income generation, legal compliance, branding, improvement, relationships, and product usability.

The development of the teaching factory learning program includes: (1) competency achievement targets: a) identifying competency standards; b) product/project-based learning, which includes competency standards, products, services, and commercialization; (2) planning and implementation: teaching materials, learning strategies, teaching modules, worksheets, learning activities, work procedures (SOP), soft skills, hard skills, culture, and work environment, all designed to achieve competency standards; (3) assessment/evaluation: assessment indicators include criteria for work, attitudes, knowledge, and skills as outlined in the competency standards of UKK/UJIKOM/AK; (4) learning outcomes: a) students achieve the expected competencies with recognition of their skills; b) products are accepted/sold in the market, leading to increased income and confidence in the workforce.

Table 3. Teaching Factory Planning Flow

No.	Aspects	Explanation
1	Planning Flow	Includes competency analysis aligned with students' and workforce needs, harmonizing the independent curriculum with the workforce curriculum, analyzing graduate profiles, market/consumer needs, determining products, creating prototypes, designing business models (BMC), implementing teaching factory learning, and managing teaching factory-based sustainable businesses.
2	Teaching Factory Learning Program	(1) Competency achievement targets: identifying competency standards, product/project-based learning; (2) Planning and implementation: teaching materials, learning strategies, teaching modules, work procedures, soft skills, hard skills, work culture; and (3) Assessment/evaluation: work indicators, attitudes, knowledge, skills based on UKK/UJIKOM/AK standards.
3	Learning Outcomes	(1) Students achieve the expected competencies with competency recognition; and (2) Products are accepted in the market, increasing income and workforce confidence.

This research highlights the importance of Life Skills Education (LSE) as a strategy to equip students with skills relevant to the demands of the Industrial Revolution 4.0. The life skills-based learning model not only prepares students for the workforce but also imparts entrepreneurial abilities to create new job opportunities. Its practical implications emphasize the need for adopting a collaborative, life skills-based learning approach as an integral part of vocational school curricula, ensuring that graduates possess competencies aligned with industrial and societal needs.

However, the study has limitations, such as a small sample size and its scope being confined to one specialization program in a single school. Implementing this model also requires additional training for teachers to effectively integrate the approach. Further research is needed to examine the model's effectiveness across diverse vocational education contexts, explore factors influencing its success, and identify potential negative effects. Longitudinal studies considering the bio-psycho-social interactions at various stages of student development are also crucial to understanding long-term impacts and strengthening the theoretical foundation of life skills education.

CONCLUSION

This study demonstrates that the Business Model Canvas (BMC)-based teaching and learning factory model effectively enhances student competencies and fosters an entrepreneurial mindset, particularly through developing soft skills such as communication, emotional management, integrity, and accountability. This model enables students to create tangible products and services and strengthens technical and non-technical skills relevant to workforce demands, especially in the creative craft product design of leather and imitation materials. The practical implications for vocational schools are significant, including the need for learning infrastructure that meets industrial standards, the reinforcement of stakeholder understanding of the concept, and the implementation of

this model to support effective policy-making, monitoring, and evaluation. These implications highlight the real-world application of the BMC model. Nevertheless, challenges such as a lack of teacher understanding of this approach and the need for interdisciplinary integration in teaching remain issues that must be addressed. Further research can expand the application of this model to produce graduates who are not only technically and non-technically competent but also capable of creating innovative products and services in line with workforce demands.

REFERENCES

Alongkrontuksin, C., Korakotjintanakarn, P., & Saehaew, T. (2024). Industrial based learning for improving problem solving skill for technical workforce labour. *Revista de Gestão Social e Ambiental*, *18*(5), e07198. https://doi.org/10.24857/rgsa.v18n5-128

Amar, A. F., Hidayat, D., & Suherman, A. (2016). Penerapan model pembelajaran teaching factory 6 langkah (model tf-6m) untuk meningkatkan motivasi berprestasi siswa di SMK. *Journal of Mechanical Engineering Education*, *2*(2), 189–198. https://doi.org/10.17509/jmee.v2i2.1479

Antony, R., Subari, A. J., & Mulyatno, C. B. (2023). Teaching factory learning management in developing entrepreneurial spirit in students: The study of SMK Muhammadiyah Gamping Yogyakarta. *Jurnal Inovasi Pendidikan Dan Teknologi Informasi (JIPTI)*, *4*(2), 163–174. https://doi.org/10.52060/pti.v4i2.1409

Berg, C. A., Klaczynski, P. A., Calderone, K. S., & Strough, J. (1994). Adult age differences in cognitive strategies: Adaptive or deficient? In *Interdisciplinary handbook of adult lifespan learning.* (pp. 371–388). Greenwood Press/Greenwood Publishing Group.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Campbell, D. T., & Stanley, J. C. (2015). *Experimental and quasi-experimental designs for research*. Ravenio Books.

Clark, H., Coll-Seck, A. M., Banerjee, A., Peterson, S., Dalglish, S. L., Ameratunga, S., Balabanova, D., Bhan, M. K., Bhutta, Z. A., Borrazzo, J., Claeson, M., Doherty, T., El-Jardali, F., George, A. S., Gichaga, A., Gram, L., Hipgrave, D. B., Kwamie, A., Meng, Q., … Costello, A. (2020). A future for the world's children? A WHO–UNICEF–Lancet Commission. *The Lancet*, *395*(10224), 605–658. https://doi.org/10.1016/S0140-6736(19)32540-1

Creswell, J. W., & Clark, V. L. P. (2017). *Designing and conducting mixed methods research* (3rd ed.). SAGE Publications, Inc.

Fajaryati, N. (2012). Evaluasi pelaksanaan teaching factory SMK di Surakarta. *Jurnal Pendidikan Vokasi*, *2*(3), 325–337. https://doi.org/10.21831/jpv.v2i3.1040

Fania, M., Iriani, T., & Arthur, R. (2024). Improving vocational student competencies through industrial class-based experiantial learning. *Jurnal PenSil*, *13*(1), 120–129. https://doi.org/10.21009/jpensil.v13i1.38151

Fitriani, S. (2024). Teaching factory and technopark as a driver of enterpreneurship and innovation: A lesson case study from Indonesian's vocational schools. *AL-ISHLAH: Jurnal Pendidikan*, *16*(3), 4213–4225. https://doi.org/10.35445/alishlah.v16i3.5247

Fitrihana, N., & Nurdiyanto, H. (2023). Improving student competence through informatics-based vocational education. *International Journal of Artificial Intelligence Research*, *7*(2), 226–231. https://doi.org/10.29099/ijair.v7i2.1180

Haryanto, J. O., Widyanto, H. A., Suryanto, H., & Santoso, A. S. (2022). Evading the "Entrepreneurial Blocks" through entrepreneurial marketing education in vocational high

schools in an emerging country. *ASEAN Marketing Journal*, *14*(2). https://doi.org/10.21002/amj.v14i2.1202

Hatmojo, Y. I., & Ikhsannudin, W. (2024). Development of teaching factory learning model in industrial automation in vocational high schools. *Jurnal Edukasi Elektro*, *8*(1), 55–64. https://doi.org/10.21831/jee.v8i1.68772

Immordino-Yang, M. H., Darling-Hammond, L., & Krone, C. R. (2019). Nurturing nature: How brain development is inherently social and emotional, and what this means for education. *Educational Psychologist*, *54*(3), 185–204. https://doi.org/10.1080/00461520.2019.1633924

Jing, Z., Turi, J. A., Lu, S., & Rosak-Szyrocka, J. (2023). Sustainability through factory-based learning in higher education. *Sustainability*, *15*(6), 5376. https://doi.org/10.3390/su15065376

Junaedi, E., Setyaningsih, S., & Suhardi, E. (2024). Implementation of the teaching factory learning model in improving students' competence at State Vocational High School 1 Pacet. *Lencana: Jurnal Inovasi Ilmu Pendidikan*, *2*(4), 57–69. https://doi.org/10.55606/lencana.v2i4.4039

Kramer, I. (2024). *Collaborative learning: Students' insights into the criteria that define effective collaboration match those of experts*. https://doi.org/10.31124/advance.24799494

Lamancusa, J. S., Zayas, J. L., Soyster, A. L., Morell, L., & Jorgensen, J. (2008). 2006 Bernard M. Gordon prize lecture*: The learning factory: Industry-partnered active learning. *Journal of Engineering Education*, *97*(1), 5–11. https://doi.org/10.1002/j.2168-9830.2008.tb00949.x

Maarof, M. G., & Bohari, M. Z. Z. (2023). Students experience using learning factory at the faculty of industrial management. *Journal of Governance and Integrity*, *6*(2), 545–551. https://doi.org/10.15282/jgi.6.2.2023.9652

MacArthur, G., Caldwell, D. M., Redmore, J., Watkins, S. H., Kipping, R., White, J., Chittleborough, C., Langford, R., Er, V., Lingam, R., Pasch, K., Gunnell, D., Hickman, M., & Campbell, R. (2018). Individual-, family-, and school-level interventions targeting multiple risk behaviours in young people. *Cochrane Database of Systematic Reviews*, *2018*(10). https://doi.org/10.1002/14651858.CD009927.pub2

Milisavljevic-Syed, J., Afy-Shararah, M., Sahin, O., & Salonitis, K. (2023). The learning factory through the sustainability lens. *Proceedings of the 13th Conference on Learning Factories (CLF 2023)*. https://doi.org/10.2139/ssrn.4471445

Mubarak, I., Warju, W., Isnantyo, F. D., & Nurtanto, M. (2020). Enhancing the learning outcomes of automotive electrical wiring diagram through Android simulation - A conceptual design for automotive vocational school. *International Journal of Psychosocial Rehabilitation*, *24*(8), 10694–10705. https://www.researchgate.net/publication/341725901_Enhancing_the_Learning_Outcomes_of_Automotive_Electrical_Wiring_Diagram_through_Android_Simulation_-A_Conceptual_Design_for_Automotive_Vocational_School

Nasheeda, A., Abdullah, H. B., Krauss, S. E., & Ahmed, N. B. (2019). A narrative systematic review of life skills education: effectiveness, research gaps and priorities. *International Journal of Adolescence and Youth*, *24*(3), 362–379. https://doi.org/10.1080/02673843.2018.1479278

Nisa, H., Isnaini, M., Utami, L. S., & Islahudin, I. (2023). Collaborative learning effect on improving students' creativity and critical thinking in the independent curriculum. *AL-ISHLAH: Jurnal Pendidikan*, *15*(3). https://doi.org/10.35445/alishlah.v15i3.3538

Nurmalasari, R., Oktaviastuti, B., & Sutadji, E. (2019). Vocational education as the answer of challenges for global competition. *Journal of Physics: Conference Series*, *1273*(1), 012040. https://doi.org/10.1088/1742-6596/1273/1/012040

O'Connor, C. A., Dyson, J., Cowdell, F., & Watson, R. (2018). Do universal school-based mental health promotion programmes improve the mental health and emotional wellbeing of young people? A literature review. *Journal of Clinical Nursing*, *27*(3–4), 412–426. https://doi.org/10.1111/jocn.14078

Patria, A. S., Krisitiana, N., Ekohariadi, E., Sutiadiningsih, A., & Sampurno, M. B. T. (2024). Teaching Factory Management on Vocational High School Case Study: Arts and Creative Industry Competency. *SAR Journal - Science and Research*, *7*(1), 29–35. https://doi.org/10.18421/SAR71-05

Putra, R. A., Widiyanti, W., Sutadji, E., & Nurhadi, D. (2021). Work and entrepreneurship readiness through 21st Century skills in vocational school students. *Universal Journal of Educational Research*, *9*(3), 497–503. https://doi.org/10.13189/ujer.2021.090309

Rahmawati, Y. (2024). Development of a workplace learning model to improve skills competency of vocational school students. *Jurnal Kependidikan: Jurnal Hasil Penelitian Dan Kajian Kepustakaan Di Bidang Pendidikan, Pengajaran Dan Pembelajaran*, *10*(3), 920–930. https://doi.org/10.33394/jk.v10i3.11977

Resnick, M. D., Catalano, R. F., Sawyer, S. M., Viner, R., & Patton, G. C. (2012). Seizing the opportunities of adolescent health. *The Lancet*, *379*(9826), 1564–1567. https://doi.org/10.1016/S0140-6736(12)60472-3

Rudiyanto, S. (2024). Development of the "learning factory" model and concept For vocational education. *Journal of Innovation and Applied Technology*, *10*(1), 1–4. https://doi.org/10.21776/ub.jiat.2024.10.01.001

Sameroff, A. (2010). A unified theory of development: A dialectic integration of nature and nurture. *Child Development*, *81*(1), 6–22. https://doi.org/10.1111/j.1467-8624.2009.01378.x

Sancassiani, F., Pintus, E., Holte, A., Paulus, P., Moro, M. F., Cossu, G., Angermeyer, M. C., Carta, M. G., & Lindert, J. (2015). Enhancing the emotional and social skills of the youth to promote their wellbeing and positive development: A systematic review of universal school-based randomized controlled trials. *Clinical Practice & Epidemiology in Mental Health*, *11*(1), 21–40. https://doi.org/10.2174/1745017901511010021

Setyowati, R., Setyowati, B., & Wardhani, E. M. (2020). Improving English communicative competence for vocational high school using scaffolding tehnique. *FRASA: English Education and Literature Journal*, *1*(2). https://doi.org/10.47701/frasa.v1i2.947

Singla, D. R., Waqas, A., Hamdani, S. U., Suleman, N., Zafar, S. W., Zill-e-Huma, Saeed, K., Servili, C., & Rahman, A. (2020). Implementation and effectiveness of adolescent life skills programs in low- and middle-income countries: A critical review and meta-analysis. *Behaviour Research and Therapy*, *130*, 103402. https://doi.org/10.1016/j.brat.2019.04.010

Soleh, A. A., Triyanto, T., Parno, P., Suharno, S., & Estriyanto, Y. (2023). Tinjauan pustaka sistematis: Model kemitraan antara SMK dengan dunia usaha dan dunia industri. *JIPTEK*, *16*(2), 126–136. https://doi.org/10.20961/jiptek.v16i2.72697

Sudarsono, B., Listyaningrum, P., Tentama, F., & Ghozali, F. A. (2024). Developing learning and training within industry model to improve work readiness of vocational high school students. *International Journal of Evaluation and Research in Education (IJERE)*, *13*(3), 1731–1739. https://doi.org/10.11591/ijere.v13i3.26175

Suhendra, I., Kasmini, L., & Sariakin, S. (2024). Implementation of the teaching factory model to enhance competence in computer and network engineering expertise at SMK Aceh Selatan. *KLASIKAL : JOURNAL OF EDUCATION, LANGUAGE TEACHING AND SCIENCE*, *6*(2), 286–297. https://doi.org/10.52208/klasikal.v6i2.1147

Sulistyowati, E., Subagyo, S., & Forijati, F. (2024). Implementation of the Teaching Factory Learning Model to Improve Student Competencies in Entrepreneurship Subjects at SMKN

1 Bagor, Nganjuk Regency. *International Journal of Research and Review*, *11*(5), 60–73. https://doi.org/10.52403/ijrr.20240508

Sutianah, C., Nurhutami, M. A., & Yamin, A. A. (2023). Implementation of BMC-based teaching and learning factory model in increasing student competencies in leather creative skills concentration and imitation in vocational school. *Jurnal Pendidikan Vokasi*, *13*(2), 178–191. https://doi.org/10.21831/jpv.v13i2.56001

Szabó, D., Csikós, F., Panker, V., & Kovács, I. (2024). Learning factories in practice: The example and development proposal of mini company located in the automotive science park based on international best practices. *SMTS 2024*, 56. https://doi.org/10.3390/engproc2024079056

Taber, K. S. (2018). The use of Cronbach's Alpha when developing and reporting research instruments in science education. *Research in Science Education*, *48*(6), 1273–1296. https://doi.org/10.1007/s11165-016-9602-2

World Health Organization. (2003). *Skills for health: Skills-based health education including life skills: An important component of a child-friendly/health-promoting school*. World Health Organization. https://apps.who.int/iris/bitstream/handle/10665/42818/924159103X.pdf

Zelazo, P. D. (2013). *The Oxford handbook of developmental psychology, Vol. 1: Body and mind* (P. D. Zelazo (ed.)). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199958450.001.0001