

Development of artificial intelligence-based teaching factory in vocational high schools in Central Java Province

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Article Info

Article history:

Received Oct 29, 2023

Revised Feb 24, 2024

Accepted Mar 7, 2024

Keywords:

Artificial intelligence

Curriculum

Digital talent

Learning model

Teaching factory

ABSTRACT

The objective of this study is to examine and assess the progress of utilizing artificial intelligence (AI) in teaching factory learning to enhance the digital skills of vocational high school (SMK) students in the province of Central Java. This study employed a qualitative approach utilizing meta-ethnography, as well as a quantitative approach employing Aiken's V formula and strength, weakness, opportunity, threat (SWOT) analysis to identify and analyze the issues that arise. The present study examines the locations of SMKN 2 Purbalingga and SMKS Telkom in Central Java. Furthermore, relevant documentation was also utilized as a source of data. The research findings indicate that the implementation of AI in teaching manufacturing learning has effectively facilitated the development of an online learning management system. This system is characterized by its organized and integrated approach inside the online learning management system. The administration of teaching materials may be conducted autonomously and facilitated by the utilization of diverse information and communication technology or e-learning functionalities, including chat, email, blogs, and social media platforms. The creation of new enterprises within the domain of AI. It is imperative for educational institutions to align their policies with the demands and requirements of the business.

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1. INTRODUCTION

The advent of the fourth industrial revolution, characterized by the integration of artificial intelligence (AI) technology, has significantly transformed several facets of human existence. The aforementioned progress necessitates substantial modifications to the educational system in Indonesia, leading to alterations in the landscape of career prospects and the existing disparity in skills among graduates of vocational schools, so giving rise to the challenges presently encountered [1]. According to the World Economic Forum's 2020 report, there is a projected demand for 97 million individuals to occupy emerging job roles, while concurrently, 85 million individuals are expected to experience job displacement due to the implementation of AI technology [2]. The user has provided a reference or citation. The implementation of factory learning in vocational secondary education (SMK) has seen significant development in response to the advent of the digitalization and AI age [3]. The integration of AI in the field of education has the potential to foster students' engagement and enthusiasm towards learning, hence facilitating the development and acquisition of a broader range of abilities [4]. The aforementioned situation, commonly referred to as

“industry 4.0”, has significantly elevated the expectations about the digital skills possessed by pupils. In order to align with the evolving knowledge and leadership capabilities of students, vocational schools need to undergo substantial modifications to their educational curricula [5]. The user has provided a numerical reference. It is imperative for SMK education to effectively guarantee that graduates possess the fundamental abilities necessary for success in the workplace. Students who possess a limited number of talents may have difficulties in coping with competitive environments. Consequently, educational institutions might employ student success rates in the context of AI-driven learning as a means of assessment [6]. The user has provided a numerical reference. The advancement of AI technology has significant implications for the adoption of teaching factory learning in vocational schools located in Central Java Province. Teaching factory learning is a fundamental aspect of production/service-based education, which adheres to industry standards and procedures (DU-DI) and simulates real-world industrial environments. The utilization of AI technologies in the field of education has become a widely accepted and customary approach to learning.

AI-based teaching factory learning is a technology application in education that aims to improve education quality and enhance students' digital skills during the industrial revolution. The user's text, “4.0” does not require any academic rewriting as it appears to be the present study identifies several problematic issues within the context of vocational education [7]. Firstly, it is observed that there is a lack of proper education and training in AI knowledge and technology among both students and teachers in the field of human resources [8]. Secondly, the digitalization and infrastructure in vocational education are found to be insufficient [9]. Thirdly, the implementation of an AI-based curriculum is deemed necessary. Furthermore, the study highlights the need for improved collaboration between SMK learning programs and the business and industry sectors, commonly referred to as DU-DI [10]. Additionally, the capacity for practical training based on AI between vocational schools and industry is found to be inadequate. Lastly, the study emphasizes the importance of revisiting the SMK education regulations and policies about the teaching factory learning process, particularly in relation to AI. The user has provided a numerical reference [11]. The advancement of teaching factory learning, which is grounded on AI, serves as the primary catalyst for the expansion and advancement of learning within the realm of vocational secondary-level education. AI has the potential to enhance the learning experience and foster the development of digital skills among both students and educators. The reason for this is because smart devices and computers are accessible to all those involved in the process [7].

The acquisition of digital talent competency among students presents a viable solution to the difficulties posed by the industrial revolution [12]. The attainment of a 4.0 grade point average and the pursuit of education play significant roles in cultivating exceptional and highly skilled pupils in SMKs. The success factors contributing to students' digital talent competencies encompass various aspects [13]. Firstly, the development of learning and innovation skills is crucial. This involves developing critical thinking and problem-solving skills, cultivating creativity and invention, and encouraging effective communication and teamwork [14], [15]. Secondly, the acquisition of information, media, and technology skills is essential. This involves cultivating information literacy, media literacy, and proficiency in information, communications, and technology [16]. Developing life and job skills is an important aspect of students' digital talent competences. The indicated attributes include flexibility, adaptation, initiative, self-direction, productivity, social and cross-cultural abilities, accountability, leadership, and responsibility [17].

2. METHOD

The research technique employs both quantitative and qualitative research methods. The research methodology employed in this study is meta-ethnography, which seeks to generate a comprehensive compilation of success determinants [18]. The primary objective of the quantitative method is to elucidate the association between the variables under investigation by constructing many latent variables that account for the link between such variables. The list of success variables was verified by many specialists by the administration of a questionnaire [19]. The many phases of the research process, specifically problem identification, development, implementation, and evaluation, have been outlined [20]. The research steps that will be conducted include:

2.1. Initial phase of study

The first phase of constructing a pedagogical framework for learning growth in a teaching factory, utilizing AI, involves gathering information data from students and teachers [21]. During this phase, data is gathered by means of interviews, questionnaires, and documentation, serving as primary sources of information from the field. The acquired data and information serve as a foundation for developing an instructional framework utilizing AI in public and private vocational schools within the province of Central Java. The study employed two distinct kinds of data: appropriate secondary data obtained through a comprehensive literature review, and primary data collected through the forum group discussion (FGD) technique. The researchers utilized internet media to collect secondary data. The internet is often regarded by

researchers as a viable medium due to its capacity to search for data sources efficiently and effectively. The utilization of mass media as an information source mitigates selection bias in literature research.

2.2. The learning development stage refers to a period in which individuals acquire new knowledge and skills

At this stage, the researcher will conduct several activities [22]. Firstly, potential mapping will be conducted to assess the capabilities of students, teachers, vocational school institutions, and industry partnerships (DU-DI) that can be leveraged by vocational schools to enhance the development of intelligence-based teaching factory learning. This mapping process aims to identify the potential resources and collaborations that can support the integration of AI in vocational education. Secondly, the potential mapping process will commence with a self-evaluation of the higher education institution. This evaluation will involve mapping the human resources, including students and teachers, as well as the curriculum/learning, infrastructure, and school governance. These aspects will be assessed to determine their readiness and alignment with implementing AI learning programs. Overall, these activities aim to identify and evaluate the potential resources and capabilities that can contribute to the successful implementation of intelligence-based teaching factory learning in SMKs. The user's text does not contain any information to rewrite in an academic manner.

2.3. The stage of learning implementation and evaluation

During the implementation and evaluation phase, researchers will assess the implementation of AI-based teaching factory learning by examining various factors such as learning outcomes, entrepreneurial skills, technological innovation suitability, performance of human resources (including students and teachers), curriculum effectiveness, infrastructure adequacy, and institutional regulations/policies. The outcomes of this assessment will be provided as suggestions to the government and affiliated educational institutions [23].

2.4. Data collection techniques

The researchers will undertake a series of investigations. The next step was organizing a forum group discussion to identify and categorize the many stakeholders involved in the advancement of AI technology. These stakeholders were identified as practitioners, regulators, and academics. The process of selecting resource personnel and researchers was conducted with careful consideration of the internal feedback from the team and relevant institutions, such as BRIN. In order to stimulate the discourse among the participants in the focus group discussion (FGD), the researchers employed structured inquiries to ascertain the advancements, methodologies, obstacles, and prospects of AI-driven educational models within public and private vocational institutions situated in the Central Java Province. The process of creating and maintaining written records or materials that provide information, instructions, or evidence about a certain subject or activity Researchers gather a diverse range of data, facts, and other pertinent information by employing documentation research techniques, such as examining photographs, archives, and other relevant sources. Additionally, interviews are conducted to get data, which is then meticulously documented in interview field notes (CLW). The purpose of the interview is to gather data and information pertaining to the implementation of the teaching factory learning model that is based on AI. The collected interview findings were further verified with the informants for confirmation. The primary objective of conducting interviews in this study was to enhance and further elaborate upon the findings of data collection acquired using observation techniques [24].

2.5. Techniques for analyzing data

The Aiken's V formula was employed by researchers for data processing purposes. The Aiken's V formula is utilized to elucidate the critical success factors (CSF) that arise from the process of integration. This formula is confirmed by using SPSS Version 26 to ascertain the relevance and importance of each CSF [25]. In addition, utilizing strength, weakness, opportunity, threat (SWOT) analysis may be employed to examine barriers and deficiencies. The SWOT analysis is employed to discern the weaknesses, strengths, opportunities, and challenges associated with the implementation of AI-based learning models. This analysis focuses on four key areas: i) the strategy of ethics and policy; ii) the strategy concerning talent development; iii) the strategy for infrastructure; and iv) the strategy for curriculum innovation [26].

2.6. Reporting the findings of research analysis

The researchers delivered a thorough paper that detailed the application of AI-based learning models in SMK within the Central Java Province. The report encompassed policy concepts and design suggestions based on decision making revision of development of AI learning model as shown in Table 1.

Table 1. Decision making revision of the development of learning models based on AI

Achievement of learning objectives (%)	Qualifications	Description
81-100	Very Good	No revision needed
61-80	Good	No revision needed
41-60	Acceptable	Revision
21-40	Poor	Revision
0-20	Very Poor	Revision

3. RESULTS AND DISCUSSION

3.1. Result

Based on the results of a survey of researchers, one of the public and private vocational schools that have implemented AI-based teaching factory learning in Central Java Province is Purbalingga 1 Public Vocational School and Telkom Vocational High School. Table 2 shows the characteristics of Purbalingga 1 Public Vocational School and Telkom Vocational High School according to the expertise competences. Success factor (critical success factor) [1], [3], [4], [6]–[10], [27]–[36], [37]–[43], of 55 respondents, in teaching factory learning based on AI, based on the potential of students at SMK Negeri 1 Purbalingga and Telkom SMKS in Central Java Province as shown as Table 3 (see in Appendix).

Table 2. Characteristics of vocational schools in Central Java

Vocational high school	Expertise competence	Notes
SMKN-1 Purbalingga	Software development and games	<p>The Productive Competencies taught are:</p> <ul style="list-style-type: none"> – Basic programming with popular computer programming languages. – Health, safety and environment (K3LH). – Fundamentals of assembly and maintenance of personal computers and computer networks. – Basics of GUI and text-based operating systems and their installation. – Algorithms and programming of desktop computers and networks and their applications. – Software modeling. – Database system and applications. – Object-oriented programming. – Web and mobile system programming
SMK Telkom Purwokerto	Software development and games	<p>Available facilities include:</p> <ul style="list-style-type: none"> – Basic computer programming and networking laboratory. – Software modeling and web developer laboratory. – Object-oriented and database programming laboratory – Teaching factory and business center <p>The competencies possessed by graduates are:</p> <ul style="list-style-type: none"> – Able to assemble and maintain personal computers. – Able to apply software for IT-based institutional applications. – Able to implement coding in IT programming. – Able to manage databases in an institution that uses DBMS – Able to design and create IT-based application software at an intermediate level.

The findings from the calculations presented in Table 3 demonstrate the content validity coefficient for each of the five success factor items. These coefficients were determined using the Aiken's V formula. The study sample consisted of 55 students from public/private SMKS in Central Java Province. The items were rated on a Likert scale with five categories. It is worth noting that a minimum content validity coefficient (V) of 0.50 was considered significant ($V > 0.50$). The questionnaire that had been provided was completed by all 55 students. The success factor of the AI-based learning model, as calculated and presented in Table 3, is as follows:

- The findings indicate that there is a low level of student attitudes towards AI technology in the context of teaching factory (M1) learning, as evidenced by a dimension score of 0.06. Furthermore, only 52.7% of the students surveyed expressed their opinions on this matter. One notable benefit is that students exhibit a high level of self-efficacy when utilizing AI technology in the context of teaching factory learning, as shown by a score of 0.510. Furthermore, nearly half of the students (49.1%) actively engage in responding to such technology.
- The analysis of learning content features reveals that the provision of teaching materials centered around AI in the form of a teaching factory is both accessible and current (K4), with an average score of 0.498. Additionally, students demonstrate a 47.3% proficiency in their responses to this material.
- On the technological elements dimension (T2), the data indicates that implementing a dependable AI technology infrastructure to support teaching manufacturing learning has received a score of 0.262.

Furthermore, around 67.3% of the surveyed students provided responses in relation to this matter. The utilization of teaching factory learning and offline technical assistance, along with the accessibility of AI equipment, has been found to be favorable, with a reported adoption rate of 0.61 and 41% of students acknowledging its usage.

- The analysis of quality factors reveals that incorporating student interactivity and AI systems in teaching factory learning (A3) has yielded a limited ability to offer constructive feedback to students, as indicated by a value of 0.391. Furthermore, the percentage of students who responded positively to this aspect was 69.1%, with a substantial proportion of students, namely 52.7%, acknowledging the satisfactory performance of the AI system in supporting teaching factory learning (A5), as reflected by a value of 0.589.
- The organizational component of the school includes training collaborations with industry (O2) to assist the implementation of an AI-based teaching factory learning model. This dimension is considered positive, with a rating of 0.67, and around 45.9% of students have responded to this aspect.

3.2. Discussion

Based on the findings of the above synthesis, the researcher proceeded to construct a management design for an instruction factory model utilizing AI. This endeavor aims to establish a model that may serve as a benchmark for educational practices in public and private vocational schools within the Central Java Province. The proposed model is outlined as follows:

3.2.1. Stage 1: preliminary preparation

In the initial phases of preparation for the establishment of an AI based teaching factory in vocational schools, the following actions need to be undertaken:

- a. The implementation of AI in SMKs requires a strong sense of determination and commitment from many stakeholders, including leaders, teachers, committees, and foundations (in the case of private schools). This collective effort is essential for establishing a teaching factory learning environment centered around AI technology. The possession of determination and dedication will serve as the primary assets in the operation of teaching factory. This commitment facilitates the process of internalizing values in teaching factory activities that are centered around AI, as well as the establishment of clear roles within these activities.
- b. Establishment of a core team for a teaching factory utilizing AI. The subsequent phase subsequent to the decision to deploy teaching factory learning entails the establishment of a central teaching factory team inside vocational institutions. The objective of this team is to assess and analyze the internal and external potential of SMKs in order to create a comprehensive map. Internal potential encompasses various elements. Firstly, it includes the human resources potential, comprising the potential of teachers, committees, alumni (regarding their success), and foundations. Secondly, it encompasses the equipment potential, specifically the equipment found in SMK that can be utilized for teaching factory-based activities utilizing AI. Lastly, it encompasses the funding or initial capital potential, including the school's or foundation's assets. If an analysis of internal potential shortcomings and weaknesses reveals, for instance, an uneven distribution of human resources (HR) in instructional factories focused on AI, it becomes imperative to devise strategies for enhancing HR capabilities. If there are discrepancies between the equipment found and the planned requirements for a teaching factory focused on AI development, it becomes necessary to undertake efforts to acquire the necessary tools in order to meet the standard equipment requirements for operating an AI-based teaching factory. The external potential factors that contribute to the market for teaching factory products/services based on AI include: i) the presence of a market for such products/services; ii) the accessibility and availability of raw materials required for production; and iii) the presence of industrial partners who can collaborate and support the development and distribution of these products/services. The presence of a viable market for products and services derived from artificial intelligence teaching factory (AI) is crucial for the internal potential of the study outcomes.

During the first phases of constructing an AI-driven teaching factory model, it is incumbent upon the development team to exert significant effort in ensuring the smooth operation of the AI-based teaching factory.

3.2.2. Stage 2: product/service development of teaching factory based on AI

Following the completion of preliminary preparations, the development team for the AI-based teaching factory will proceed to the subsequent phase, which entails the creation of goods and services for the AI-based teaching factory. The implementation of AI-driven teaching factory goods and services within vocational schools is preceded by a comprehensive market requirements assessment and an evaluation of the internal capabilities of vocational schools. At this juncture, concepts or proposals for instructing factory-produced goods or services utilizing AI are expected to be generated [8]. This concept is subsequently

employed as a foundation for formulating business strategies and production planning, specifically pertaining to the production of goods and services within teaching factories that are centered around AI, with a focus on its implementation within SMKs. The aforementioned mature manufacturing plan will thereafter be transformed into an early prototype. Subsequently, the outcomes of the prototype will be subjected to testing. The obtained test results will be utilized for the purpose of enhancing the quality of items that are intended to be introduced to the market and made available to consumers. The presence of industry partners during the early product/prototype development phase of SMK is fortuitous. Once the AI driven teaching factory product has effectively reached stage/phase 2, it becomes suitable for integration into teaching factory learning and may be prepared for production and commercialization targeting customers. During the second phase, educational institutions are required to establish a systematic framework for instructing manufacturing managers within SMKs. There is an expectation that this organizational structure will not align with the organizational structure of SMK. The findings of this study indicate that vocational schools that possess a distinct organizational framework for managing teaching factories, independent from the school's overall organizational structure, demonstrate effective and professional administration of these facilities.

3.2.3. Stage 3: implementation in vocational schools and product/service innovation teaching factory based on AI

The third stage is the implementation of a teaching factory approach based on AI in vocational schools based on products or services that have been developed by the teaching factory team. This stage is divided into two areas, namely in becoming a historic milestone that teaching factories based on AI began to be included in learning in vocational schools and leaving school became a historic milestone in which vocational schools began to have products/services that can be utilized by the community or consumers with the existence of these two areas, then there are also 2 activities taking place [34]. Activities inside the school are the teaching factory learning process and activities outside the school are marketing. Activities in teaching factory learning in vocational schools can be grouped into 3 groups, namely:

a. Preparation, namely preparing teaching factory learning based on AI which will be carried out by vocational schools students according to the level and current curriculum. This stage includes the following steps:

Step 1: analyze the competencies that suit the learners

- Make product analysis according to core and basic competencies (KI/KD) analyze the basic competencies that are delivered from making products. The analysis was carried out by the production teacher together with the head of the study program. Products that are able to deliver as many basic competencies as possible are good products.
- Make a product work schedule product work starts from the beginning, production and post-production. A good product is that the work can be done according to the existing schedule and the basic competencies can be conveyed in the product.
- Scheduling continuous production in product design considering the same production and carried out continuously within a certain period of time. This affects the sustainability of the product which is continuous and continues to be needed by the community.
- Calculating investment capital requirements, arranging investment capital effectively and efficiently. The minimum selling product price is the same as the price of raw materials. This works because the product is a learning medium that can be continuously worked on.

Step 2: preparation of a teaching factory model job sheet based on AI

- Compile job sheets based on goods orders.
- Preparing job sheets based on the complexity of goods orders. Preparing job sheets based on the complexity of goods orders and arranged according to the basic competencies that students deliver.
- Calculating the work time allocation, arranging the time for completing the work in accordance with the request of the order and in accordance with the basic competencies achieved by the students.

Step 3: conditioning students

- Growing students' motivation in working on goods.
- Fostering a high work ethic.
- Strengthen team collaboration to achieve high production.
- Mastering good communication between students and teachers.

Step 4: conditioning the factory atmosphere

- Enter the workshop/lab according to industry working hours. Enter the workshop.
- Work follows industrial hours.
- If there is a product error, the product is revised until it is correct.

- b. The implementation phase of AI-based teaching factory learning encompasses many stages, commencing with the organization of teaching factory scheduling and progressing through the execution of goods/services production through teaching factory learning, accompanied by a mentoring process. The procedural guidelines for the implementation of teaching factory, which is based on AI, are outlined as follows:

Step 1: set the processing time.

- Paying attention to the curriculum content, adjusting the curriculum content in the RPP to the basic competencies achieved by students.
- Adjusting the time to align the academic calendar in fulfilling production.
- Pay attention to the learning activities of students per week, calculate the number of hours of student learning to produce products.

Step 2: counting the number of subjects

- Count the number of subjects involved analyze the number of subjects involved to produce goods.
- Preparation of job sheets based on the complexity of goods orders and arranged according to the basic competencies of students.

Step 3: calculating facilities and infrastructure

- calculate the number of workshops involved calculate the number of workshops involved in producing goods.
- Count the number and types of facilities and infrastructure calculate the number and types of facilities and infrastructure in the school environment.
- Performing an analysis of facilities and infrastructure for teaching factory learning based on AI, analyzing facilities and infrastructure in teaching factory learning based on AI.

Step 4: product quality checking

- Create product quality standards. After obtaining approval from the customer regarding the goods ordered, it is hoped that the quality will be the same as the existing product.
- Speed in production, for example product 1 is needed 5 meetings, product 2 is needed 2 meetings and so on
- Analyze product quality in accordance with existing products by making product quality standards.
- Speed in product delivery. After the product is finished, it is immediately sent to the customer because the quality and speed of delivery affect the product. Especially for food products that must be sent to consumers immediately.
- Post product evaluation is carried out continuously after product control is finished. This is to minimize errors that may occur after production. In other words, post-production quality control is carried out.

Step 5: compilation of an assessment of the teaching factory model based on AI

- Quality assessment and quality assessment function (technical assessment, work method and results) and functional aspects (assessment that refers to the weight of the function).
- Assessment of processing time for each product produced.

- c. Innovation of teaching factory products and services based on AI or developing new products in response to market demand and acceptance of teaching factory products and services based on AI created in vocational schools. In the third stage, teaching factory's activities are driven by a focus on product and service innovation, enabling the company to adapt and expand in response to evolving market trends and customer demands. Hence, establishing an innovation division dedicated to creating and advancing products and services becomes imperative. The figure above depicts a teaching factory's growth pattern that utilizes AI. It visually demonstrates the process of conducting an improvement cycle for the products and services offered by the teaching factory, which are centered around AI. The continuous implementation of the improvement cycle is necessary to train manufacturing goods based on AI.

By implementing this improvement cycle, two outcomes can be expected. Firstly, there will be an enhancement in the quality of teaching factory products/services that are based on AI in vocational schools. Secondly, derivative products/services will be developed that align with market trends and demands. The pedagogical approach of the teaching factory, which incorporates AI and extracurricular activities, might be regarded as a form of marketing. Marketing operations necessitate a compelling product profile and branding packaging that may enhance customer trust in the goods and services offered by SMK, which are based on AI in the context of teaching factory. In addition to marketing initiatives, a study was conducted to assess customer acceptance and demands for AI-based teaching factory goods and services. The findings obtained from this survey will thereafter be utilized in the iterative process of enhancing AI-based education factory goods and services.

3.2.4. Implementing a teaching factory model based on AI

Achievement of talent graduates of students in the teaching factory model based on AI, includes four domains, namely:

- a. Mastery of student knowledge can be fulfilled through theoretical lectures with teaching factory learning based on AI online and offline, but the other three domains cannot be fully fulfilled because the process of internalizing these three domains cannot be achieved. Many students need interaction with industry stakeholders (DU-DI), such as: street vendors, apprenticeships, practicums to hone skills. At a minimum, integrated learning between offline and online must be possible.
- b. The absence of a virtual laboratory in implementing AI learning and all the obstacles, leads to difficulties in fulfilling graduate learning outcomes. Therefore, simplification of the curriculum or restructuring of this curriculum needs to be done immediately, especially in fulfilling the achievements of AI-based teaching factory learning in vocational schools in Indonesia.
- c. Developing students' digital talents for product development, new product creation and entrepreneurship (creation of new industries). To achieve certain competencies (competence standards), the development of AI talent requires an ecosystem that can support the learning process and the innovation process.
- d. The establishment of this ecosystem requires the collaboration of various parties, the quad helix collaboration involving academia, business, government, and community (ABCG). The requirements for this ecosystem are to be able to: i) support education to produce talented students and entrepreneurs; ii) supporting product growth and the creation of new products; and iii) providing financial resources, facilities, and infrastructure, including equipment, tools and data needed to improve talent competence in the field of AI. It is hoped that this ecosystem will be able to produce competent talent, which will later support cycles in the ecosystem in a sustainable manner. In creating a learning ecosystem and innovation ecosystem, it begins with the process of forming an initial entity as the driving force of the ecosystem. Setting up management and financial processes is the main starting factor, so that ecosystem entities are expected to start from bringing together government and industry. Conducting a SWOT analysis (Table 4) to assess the progress of AI models in SMK, focusing on SWOT.

Table 4. SWOT analysis

SWOT analysis	Strength	Weakness
	<ul style="list-style-type: none"> - Human resources (students and teachers) - Technology - Infrastructure - Learning media 	<ul style="list-style-type: none"> - Human resources are deficient in information, education, and skills related to AI. - The costly nature of acquiring knowledge in AI. - Availability of learning media does not support the development of AI. - Insufficient regulations in the development of AI learning.
<p>Opportunity</p> <ul style="list-style-type: none"> - Entrepreneurship in the field of AI - Development of industry in the field of AI - Increasing the talents and competencies of students who are familiar with digital technology. - Hope for AI technology for more effective and efficient decision making for institutions, teachers and students 	<p>Strategy SO/Aggressive</p> <ul style="list-style-type: none"> - Develop an AI-based curriculum in accordance with technological developments in Industry 4.0 - Establishing a Virtual Lab for special technology development in the field of AI and other fields. - Create and use AI-based learning media 	<p>Strategy WO/Stability</p> <ul style="list-style-type: none"> - Offer instruction in AI for students and educators. - Provide socialization and education about entrepreneurship, especially in - Design school regulations/policies related to infrastructure to be able to support development
<p>Threat</p> <ul style="list-style-type: none"> - Misuse of AI technology for users - Talented human resources prefer to work abroad or foreign companies rather than at home because they get paid more. - Unauthorized use of private data that evades oversight 	<p>Strategy ST/Verification</p> <ul style="list-style-type: none"> - Conduct periodic evaluations by schools (SMK) regarding the use or development of AI technology - Conduct outreach and education about the importance of data privacy 	<p>Strategy WT/Defensive</p> <ul style="list-style-type: none"> - Provide career and talent consulting assistance for students and teachers - Provide information on the development of AI in the digitalization era

4. CONCLUSION

The teaching factory learning model, which utilizes AI, has proven successful in developing an online learning management system (SPPD). This system has effectively facilitated the transition from the pandemic period to the new normal, by providing a well-organized and comprehensive platform for online learning (Online-LMS). The independent management of teaching factory instructional materials, utilizing AI, may be facilitated by incorporating different information and communication technology (ICT) or

e-learning tools. These tools include chat platforms, email systems, blogs, and social media platforms like as Google, WhatsApp, Zoom, and Twitter. The incorporation of teaching factory learning that utilizes AI serves to cultivate the entrepreneurial mindset among students and graduates specializing in AI. Numerous alumni have successfully established innovative start-ups within AI and are actively engaged in the AI sector. The adaptation of school policies for controlling the growth of teaching factory learning infrastructure, especially those based on AI, is still necessary to align with the industrial sector's requirements and technological advancements during the Industrial Revolution 4.0.

APPENDIX

Table 3. Success factors (critical success factor) ([1], [3], [4], [6]–[10], [27]–[36], [37]–[43]) teaching factory learning based on AI in SMK Negeri 1 Purbalingga and Telkom SMKS students in Central Java Province

Group	Code	Critical success factors (CSF)	Definition	V Coefficient	Percentage (%)
Student Factor	M1	Attitudes towards teaching factory learning using AI	Willingness to participate in teaching factory learning using AI technology	0.060	52.7
	M2	Experience and knowledge of AI	Ability to use AI to complete teaching factory learning tasks	0.366	54.5
	M3	Self-efficacy using AI technology	Ability to interact with AI technology	0.510	49.1
	M4	Learn to be independent and self-disciplined	The ability to enable students to learn and do something, especially something difficult in the application of AI technology in every teaching factory learning process	0.424	76.4
Learning Content Factor	K1	AI technology content quality	The quality of writing, videos, and images, meets generally accepted standards	0.407	49.1
	K2	Course flexibility	Students' perceptions about the efficiency and effects of adopting AI technology in the Teaching factory learning process	0.431	67.3
	K3	The material is in accordance with the curriculum	Providing teaching factory learning materials using AI technology in accordance with the curriculum/RPS that has been prepared by the school	0.413	49.1
	K4	Learning materials are available and up to date	Fast provision of learning materials	0.498	47.3
Technology Factor	T1	Quality use of AI technology	The quality of AI technology can be evaluated by data transmission speed, error rate	0.314	63.6
	T2	Reliable technical infrastructure	The level of accuracy, reliability and consistency of information	0.262	67.3
	T3	Available online communication tools	Availability of online communication tools (e.g., email, and Facebook)	0.519	58.2
	T4	Technical support in teaching	Availability of offline learning and technical support, ability to access tools with AI technology	0.611	41.8
The quality factor of the teaching factory model is based on AI	A1	Ease of use of AI technology	To what extent can users use the teaching factory learning model with AI technology?	0.576	43.6
	A2	AI system functionality	Able to adapt to learning needs	0.431	50.9
	A3	AI system interactivity	AI technology is capable of providing critical feedback to students	0.319	69.1
	A4	AI language support in supporting the teaching factory learning process	The ability to explain teaching factory learning terminology with AI technology can be understood by students	0.490	56.4
	A5	AI system response in supporting the teaching factory learning process	The time elapsed from user manipulation to feedback from the AI system is acceptable to students	0.589	52.7
	A6	Simplification of teaching factory learning with AI technology	Able to reduce repetitive work for students	0.416	50.9
	A7	Evaluation of teaching factory learning with AI technology	AI helps monitor student performance	0.467	49.1
	A8	Calculation of teaching results	AI systems are capable of calculating big data to improve teaching	0.513	47.3
	A9	Automatic reporting	The AI system is capable of creating student progress report profiles	0.553	47.3

	A10	Evaluation of learning content	Ability to examine gaps in learning content	0.527	69.1
Organization	O1	Joint Industry Training (IDUKA)	Provide learning model training for both students and teachers	0.528	54.5
	O2	School leadership support in the teaching factory learning process with AI technology	School leaders provide support for the learning process with AI technology	0.508	49.1
	O3	School policy in the teaching factory learning process with AI technology	There is a school policy regarding AI technology in supporting learning	0.472	43.6

ACKNOWLEDGEMENTS

We would like to thank the Director of the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia, who has provided funding support for Basic Research (Fundamental) grants in this first year with the 2022-2023 budget so that this research can run smoothly and well. Apart from that, the Research Team would also like to thank the Director of Vocational School Development at the Ministry of Education and Culture as a Research Partner, the Leadership of UHAMKA University and the Chair of the UHAMKA Research and Development Institute for providing opportunities for this research, as well as to all Principals, Teachers and Students of classes X-XII of SMK Negeri 1 Purbalingga and Telkom Vocational School in Central Java Province.




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