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CRITICAL SUCCESS FACTORS IN IMPLEMENTING TEACHING FACTORY-BASED COMPETENCY FOR VOCATIONAL HIGH SCHOOL STUDENTS

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Abstract: The teaching factory concept is the basis for a new model that attempts to integrate academic and industrial worlds. This study aims to identify and explore critical success factors in implementing the teaching factory model. Learning activities that are carried out in work environments are able to provide students with relevant learning experiences and develop teachers' learning objectives which in turn will improve the overall quality of teaching and learning processes in which knowledge about industrial worlds is constructed. This research used qualitative and quantitative methods, adopting Kitchenham's approach to identify the critical success factors and using reliability and validity testing to validate the critical success factor items. This research was conducted in five vocational high schools in Central Java Province, with the respondents of 140 students. This research shows that there were 27 critical success factors of teaching factory implementation, three of which are the main factors: business and industrial worlds, schools and teachers, and students.

Keywords: competency, teaching factory, vocational education

FAKTOR KEBERHASILAN KRITIS IMPLEMENTASI KOMPETENSI BERBASIS *TEACHING FACTORY* UNTUK SISWA SMK

Abstrak: Konsep *teaching factory* adalah dasar untuk model baru integrasi antara dunia akademik dan industri. Studi ini bertujuan mengidentifikasi dan mengeksplorasi faktor-faktor keberhasilan penting yang terkait dengan penerapan model pembelajaran berbasis dunia industri. Belajar di lingkungan kerja akan menumbuhkan pengalaman belajar yang relevan dan dapat mengembangkan tujuan pengajaran guru untuk meningkatkan kegiatan belajar mengajar dengan pengetahuan berdasarkan standar industri. Penelitian ini menggunakan metode kualitatif dan kuantitatif, yang merupakan pendekatan Kitcheham untuk mengidentifikasi faktor keberhasilan kritis dan pengujian *realibility* dan validitas untuk memvalidasi item faktor keberhasilan kritis. Penelitian ini dilakukan di lima SMK di Provinsi Jawa Tengah, dengan responden 140 siswa. Penelitian ini menunjukkan bahwa ada 27 faktor keberhasilan kritis iplementasi *teaching factory*, dengan 3 faktor utama yaitu dunia bisnis dan industri, sekolah dan guru, serta siswa.

Kata Kunci: kompetensi, pendidikan kejuruan, teaching factory

INTRODUCTION

Indonesian President, Joko Widodo, confirms that people in Indonesia is now facing major global challenges regarding to the 4.0 Industrial Revolution in the 21st century. It links to not only a competitive business environment, but also to a wider industrial revolution. To answer this, some prominent actions is preferable to take into account, one of which is the implementation of teaching factory concept, an action-oriented learning approach referring to procedures and standards applied in industry and is carried out in an atmosphere like what happens in the industry (Reisinger et al., 2019). The big wave of the Industrial Revolution 4.0 has promoted tremendous tension, terrible destructive technology, and turbulence in new life, which leads to increasing global competition (Prinz et al., 2016).

The stipulation of the Presidential Instruction on vocational high schools revitalization aims to bring significant changes for vocational high schools in Indenesia to be better and more competent. To win the competition, Indonesia has to prepare human resources, who have adequate qualification and basic competence in facing the global challenges. In addition to arapid infrastructure transformation in the past four years, improving human quality is an essential prerequisite to avoid Indonesia from an economic situation in which low-wage economies get stuck in the middle-income trap (an interview with the education expert staff of the Ministry of Education and Culture of Central Java Province, Mr. Sulistiono, July 2019).

Headed for the third year of the revitalization of vocational high schools, in accordance with the mandate of Presidential Instruction No. 9 year of 2016 concerning Vocational Education Revitalization, several positive achievements have been gradually appeared. In line with the increasing number of vocational high school graduate workers in 2018, the vulnerable unemployment rate of vocational high school graduates has decreased each year (an interview with the education expert staff of the Ministry of Education and Culture of Central Java Province, Mr. Sulistiono, July 2019). The adjustment of Curriculum and Industrial Cooperation to develop vocational education has related to the competencies of the needs of graduate users (link and match). Thus the Ministry of Education and Culture made some adjustments implemented in vocational education curriculum. While previous curriculum used a supply-driven approach, recently, the new curriculum has been adjusted to be demand-driven.

The business and industrial worlds are actively involved in the vocational education process at the school level. Recently, vocational high school is running a curriculum which considers the demands of the business and industry world. Besides, the curriculum is developed collaboratively with business and industrial sectors. Equally, the business and industrial manufacturing take parts to govern the curriculum by 70 percent (Wahjusaputri & Siregar, 2017).

In the industrial learning, the theory contributes to the ongoing projects. The students' problems in the industry are the starting point of training activities in industrial learning. Product-oriented learning theory is exemplified in this contribution from each vocational training course occupied by students theoretically and practically. Consequently, the problems which appeared from the students and infrastructure become a starting point for the learning processes and students' competencies development (Dimitris Mavrikios et al., 2018).

Teaching factory is a concept of production or service-based learning in a vocational high school which refers to the standards and procedures applied in the industry and is carried out in an industrial atmosphere. The industrial class aims at transferring what happens in industrial environment activities to the courses in class (Rentzos et al., 2014).

The concept of a teaching factory is production-based learning integrated with classroom learning and a practical environment to foster accurate and relevant work and learning experiences according to the business and industrial needs. The teaching factory concept is the basis of a new integration model between academic and industrial sectors. The first lessons are "factory-to classroom" and "academia-to industry".

The concept of a teaching factory aims to transfer the work environment to the classroom. Learning through the work environment will provide relevant learning experiences for students and develop teachers' teaching objectives to improve teaching experiences based on industry standards. The concept of teaching factory is created because of three things: (1) Conventional learning is not enough; (2) Students get benefits from hands-on practical experience; and (3) Team-based learning experiences involve students, staff instructors, and industry participation which enrich the educational process and provide tangible benefits for all parties (Rentzos et al., 2014).

According to Tvenge et al. (2016), the teaching factory aims to obtain students' knowledge by creating a school curriculum that provides standard regulation according to industrial procedures. Further said by Sudhoff et al. (2020), the implementation of the teaching factory learning concept in the vocational high school's environment develops relevant work experience in the form of a factory as a place of learning. This helps students to be able to evaluate their ability to improve their learning by using technology; one of the technologies carried out is the teaching factory training phase so that teaching is practiced in knowledge transfer. The first element involves an educational approach to learning and teaching. The second element, "factory" describes the industrial environment needed for vocational education related to the field of school studies (Brunoe et al., 2019).

The teaching factory model enhances individual reflection as a dimension in the cycle as a part of the learning processes. The purpose is to evaluate students' performance, which provides an understanding of the knowledge, skills, and attitudes obtained from learning in the industry. Evaluation tools are essential in identifying areas to improve practice and optimize learning. Students are encouraged to explore emotions and questions, reflect, and provide feedback to their friends with another (Baena et al., 2017).

The learning factory is the key objective of the teaching factory model prepared to move towards assimilation and accommodation to transfer learning in the direction of the industrial revolution 4.0 (Wafroturrohmah et al., 2020). The students' ability to develop production competence is a key requirement for industry-based learning (Stief et al., 2018). The industrial practitioners provide lessons and laboratory industrial-standard introduced to students in designing products and manufacturing, and they also give guidance and motivation to manufacture design products (Mourtzis & Vlachou, 2018).

In industrial learning, the latest advances in information and communication technology (ICT) must be included to improve school productivity and efficiency (Baena et al., 2017). According to Baena et al. (2017), the quality of industrial learning is determined from the level of education and the integrated technology. Firstly, the relevant subject matter must be determined according to future production needs. Students' competencies are the the main goal of industrial learning. Industry learning aims to understand product modeling and modify various products as a basis for developing new product configurators.

Secondly, to structure product configurators that provide manufacturing costs or sales prices and offer data needed for manufacturing products, the students are equipped with literature and methods for creating certain products. Additionally, students are given a short lecture by a teacher, outlining and modeling the concepts from the provided literature. After taking the related courses, the students are trained in the workshop/laboratory through discussion groups (Brunoe et al., 2019).

In a study conducted by Stojkić and Bošnjak (2019), the level of education and technological infrastructure must be aligned to complete the design of industrial learning. The industrial learning curriculum (Learning-Factory-Curriculum-Guide) must create a competency-oriented learning system in which relevant subject matter must be determined following the needs of the industry integrated into the school curriculum.

According to Reining et al. (2019), the industrial learning uses the process of learning a training approach in an industrial environment by adopting renewable industry knowledge and technology, so the students can create innovations in improving critical thinking skills while solving production problems. An innovative learning environment has a positive impact on students because the students' ability to develop potential products is the main requirement for industrial-based learning (Stief et al., 2018).

Industry 4.0 influences both students and organizations (schools) with technical innovations in production. It is said that industrial learning must have a learning/teaching component and a production component. To accommodate the learning process, the production component can be either in the form of virtual or physical and products/services (Abele et al., 2016).

METHODS

This research used a systematic literature review from Kitchenham to attain critical success factors from the teaching factory. After that, the critical success factor items were validated by using a questionnaire with reliability and validity analysis. The systematic literature review by Kitchenham aims to identify, evaluate, and interpret all research results which are relevant to the research questions (Wahjusaputri et al., 2019). Based on these objectives, a systematic literature review has 3 main stages: identification, evaluation, and interpretation.

Researchers determined a research question at the identification stage, "What are the critical success factors of teaching factory implementation?". The relevant research results in several database locations had been based on some prior research questions found in ScienceDirect, Scopus, SINTA, and Springerlink. At the evaluation stage, researchers selected relevant research results based on defined exclusion and inclusion criteria.

Table 1. Exclusion and Inclusion Criteria

Exclusion	Inclusion
Bias Literature	Following the research question
Incomplete Article	Related to the successful implementation of the teaching factory
Not in English or Bahasa	

After evaluating the results of relevant research, critical success factor data related to the implementation of the teaching factory were extracted. At the interpretation stage, researchers conducted data translation or critical success factor items, so that there would be no identical definition among the items.

Critical success factor items obtained from the systematic literature review method were validated using questionnaires that were further analysed using validity and rehabilitation testing. The questionnaire was distributed to 140 vocational school students in Central Java Province. The data were analysed quantitatively along with descriptive analysis techniques. One of the functions of descriptive analysis is to present research data in a simple form and to portray an overview of research results. The qualitative data analysis technique was also conducted to understand the results of validation data (assessments) from experts who had provided valuable information for the advancement and comprehensiveness of the teaching factory model.

FINDINGS AND DISCUSSION

Findings

Using the Kitchenham approach, this research discovered a list of critical success factors (CSF) in implementing the teaching factory model. Based on research questions, exclusion, and inclusion criteria, 10 relevant research results were used to determine the critical success factor of the teaching factory. Of the 10 relevant research results, the process of synthesis and data extraction was obtaineds so that 27 items of critical success factors were obtained. The 27 critical success factors can be seen in Table 2.

Critical success factor items were validated by reliability and validity testing in the form of questionnaires. This questionnaire was distributed to 140 students of Vocational High Schools in Central Java Province. The questionnaire filled by 140 students was calculated as the content validity coefficient for each critical success factor item. Based on the significance of the content validity standard (V), for 140 students (appraisers) and five categories (Likert scale), the minimum value of content validity (V) of the significant coefficient is $r_{count} > r_{table}$. Testing the validity of a critical success factor item aims to measure whether the item is suitable for use (valid) or not. To determine the data validation, the correlation test of the significant coefficient was set at the signification level of 0.05. Data validation tests show that all critical success factor items were valid and can be used because $r_{count} > r_{table}$. In other words, the entire item had good content validity.

Table 2. Data Extraction Result

No.	Item Critical Success Factor	Article
1.	Work experience from Business and Industrial World	(Lugaresi et al., 2020; Prianto et al., 2020)
2.	Training/seminars/ workshops from Business and Industrial World	(Krúckhans et al., 2015; D. Mavrikios et al., 2013)
3.	Training participation	(Barton & Delbridge, 2006)
4.	Develop entrepreneurship potential	(McMullen & Shepherd, 2006; Yohana, 2020)
5.	Understand the theory of teaching factory management	(Karre et al., 2019; Wermann et al., 2019)
6.	Understand the principles of teaching factory learning	(Karre et al., 2019; Wermann et al., 2019)
7.	Industrial work atmosphere in learning	(Prinz et al., 2016; Wermann et al., 2019)
8.	Technology in the industry in learning	(Li et al., 2019; Wermann et al., 2019)
9..	Industrial work culture in learning	(Wafroturrohmah et al., 2020)
10.	Work ethics	(Spilla et al., 2020)
11.	High sense of responsibility in completing work	(Prinz et al., 2016)
12.	Self-confidence	(Prinz et al., 2016)
13.	Understand, obey, and teach social norms	(Haris, 2017)
14.	Good communication with Business and Industrial World	(Schmidbauer et al., 2020)
15.	Knowledge about the Business and Industrial World standards	(Prinz et al., 2016)
16.	Practical skills according to my subjects	(Baena et al., 2017)
17.	Guidance and tutor from the teachers	(Syauqi et al., 2020)
18.	Business and Industrial World contributions	(Prinz et al., 2016)
19.	Training for instructors provided by Business and Industrial World	(Krúckhans et al., 2015)
20.	Training for students provided by Business and Industrial World	(Krúckhans et al., 2015)
21.	Training for school managers provided by Business and Industrial World	(Krúckhans et al., 2015)
22.	HR/instructor facilities	(Kuat, 2018)
23.	Infrastructure facilities	(Kuat, 2018)
24..	Learning resource facilities	(Kuat, 2018)
25.	Schools' initiative to cooperate with Business and Industrial World	(Centea et al., 2019; Dimitris Mavrikios et al., 2018)
26.	Collaborate with the various industrial world	(Darun et al., 2019)
27.	School maintain the production process	(Sudhoff et al., 2020)

Next, the researcher calculated the homogeneity-reliability coefficient for each item of the success factor by using the given Aiken's H formula using SPSS. Based on significant homogeneity (H) reliability standards, the minimum significant coefficient of homogeneity reliability value (H is 0.51 (H> 0.51). Therefore, if the value H<0.51, then the item would be eliminated. Based on the results of reliability testing, it can be seen that all items were reliable so that there was no elimination to the items.

Discussion

In the earlier section, from previous research in this study obtained 27 items of critical success factors (Table 3). If observed more deeply, the critical success factor of the teaching factory consisted of 3 main factors: business, industrial world, and school and teacher. Students represented in Figure 1 with these three elements could determine the success of the implementation of the teaching factory.

The most influential factor in the success of the teaching factory is the synergy between the teaching factory and the world of business and industry. Learning through a teaching factory also aims to develop good characters and work ethics of discipline, responsibility, honesty, cooperation, and leadership that the industry needs. The absorption of alumni in the business and industrial worlds is one of the characteristics of teaching factory success. Therefore, teaching a factory curriculum must involve the business and the industrial worlds. Based on Figure 1, the factors that affect the success of teaching factors in the industry are the contribution of industry in improving student work experience, carrying out training/workshop/seminar for students, providing training for teachers and teaching factory instructors, and also providing training for school administrators.

Table 3. Critical Success Factors of Teaching Factory Implementation

No.	Item Critical Success Factor of a Teaching Factory	V Coefficient	H Coefficient	Sig
1.	Work experience from Business and Industrial World	0,691	0,917	0,000
2..	Training/workshops/seminars from Business and Industrial World	0,626	0,918	0,000
3.	Participated in the training held by Business and Industrial World	0,684	0,917	0,000
4.	Develop entrepreneurship potential	0,520	0,920	0,000
5.	Understand the theory of managing teaching factory learning	0,543	0,919	0,000
6.	Understand the principles of teaching factory learning	0,623	0,918	0,000
7.	Industrial work atmosphere in learning	0,555	0,919	0,000
8.	Technology in the industry in learning	0,484	0,920	0,000
9..	Industrial work culture in learning	0,441	0,921	0,000
10.	Work ethic	0,489	0,920	0,000
11.	High sense of responsibility in completing work	0,438	0,921	0,000
12.	Self-confidence	0,487	0,920	0,000
13.	Understand, obey and teach social norms	0,491	0,920	0,000
14..	Good communication with Business and Industrial World	0,495	0,920	0,000
15.	Knowledge about the subject matter provided according to Business and Industrial World standards	0,456	0,920	0,000
16.	Practical skills according to my subjects	0,251	0,923	0,000
17.	Guidance and tutor from the teachers	0,532	0,919	0,000
18.	Business and Industrial World contributions	0,633	0,918	0,000
19.	Training for instructors provided by Business and Industrial World	0,610	0,918	0,000
20.	Training for students provided by Business and Industrial World	0,570	0,919	0,000
21..	Training for school managers provided by Business and Industrial World	0,396	0,922	0,000
22.	HR/instructor facilities	0,585	0,919	0,000
23.	Infrastructure facilities	0,520	0,920	0,000
24.	Learning resource facilities	0,501	0,920	0,000
25.	Schools actively offer cooperation with Business and Industrial World	0,457	0,920	0,000
26.	Having collaboration involving more than 1 Business and Industrial World	0,388	0,921	0,000
27.	The production process is carried out at school	0,523	0,919	0,000

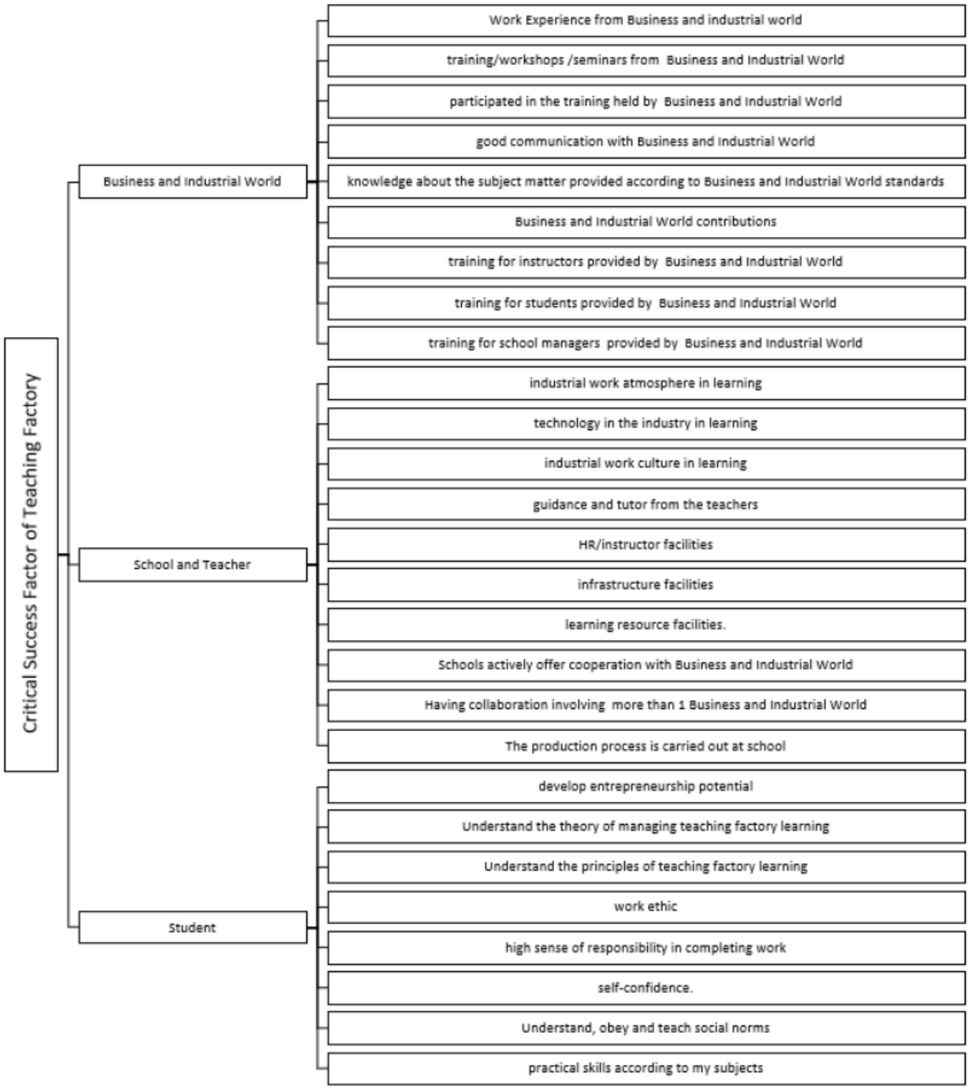

Figure 1. Three Main Factors of Teaching Factory Implementation's Critical Success Factor

The second main factor that influences the successful implementation of teaching factories is schools and teachers. Improving the quality of learning outcomes is not just to equip competence (competency-based training) but towards learning that equips the ability to produce goods/services (production-based training). The products can be used as a vehicle for the development of creative technopreneurs to build an industrial culture in schools. Therefore, the readiness of school infrastructure facilities in implementing teaching factory learning is a must. In addition, the competency standards used by schools in the implementation of teaching factories are competencies needed in the industrial world. This is expected to prepare students to face the demands of the needs of the industrial world.

In addition, schools must prepare facilities and competency standards. Teachers are also required to improve their competency while transferring the knowledge needed by students. Finally, teachers are those who have academic qualifications and industrial work experience. By saying this, the teachers are expected to transform knowledge while supervising the process to present "finished products on time".

Learning media used in the teaching factory process uses production work as a medium for the learning process. Production work can be industrial order or standard products. The instructor must first understand this product as a medium for competency development through product function, dimensions, tolerance, and completion time.

The Department's Production Unit can be the place at which production from teaching factories can be directly distributed to the community. In addition to partner industry, the products can be managed by the Production Unit to stimulate technopreneurs skills for vocational learning.

The third main factor that determines the success of the implementation of the teaching factory is the students. Students with a good quality in both academic and potential skills have an opportunity to enter the teaching factory program. In addition to skills and academics, students must also have a high sense of responsibility and work ethics in implementing learning and training from schools and the industrial world.

CONCLUSION

The systematic review method with Kitchenham approach identified various studies related to the implementation of teaching factories. The data were synthesized to obtain 27 critical success factor items tested using rehabilitation and validity testing. In practical terms, the overall items produced can help schools evaluate and improve the quality of teaching factory implementation. This research contributes to the Kitchenham approach that was successfully demonstrated in the implementation of teaching factories. Other researchers in similar research activities can adopt methodologies and stages that researchers have done.

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