Al-Ishlah: Jurnal Pendidikan
Vol.16, 3 (September, 2024), pp. 4213-4225
ISSN: 2087-9490 EISSN: 2597-940X, DOI: 10.35445/alishlah.v16i3.5247

Teaching Factory and Technopark as a Driver of Entrepreneurship and Innovation: A Lesson Case Study From Indonesian's Vocational Schools

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ARTICLE INFO

Keywords:

Teaching Factory;
Technopark;
Entrepreneurship
Innovation;
Creativity

Article history:

Received 2024-04-15
Revised 2024-07-05
Accepted 2024-08-09

ABSTRACT

To enhance the quality of vocational education, the Indonesian government has prioritized two projects: Teaching Factory and Technopark. Teaching factory model integrates vocational school learning with industry standards and procedures in a setting that mirrors real world industrial environments. Technopark serves as the hub of several teaching factories that connect industries, educational institutions, and pertinent agencies to foster collaboration. These two initiatives are intertwined and interdependent on one another. The study's objective was to explore the impacts of the deployment of the teaching factory and technopark to students' skills, educational outcomes and their teachers' competencies. Data were garnered from four public vocational high schools in Indonesia through non-participant observation and semi-structured interviews involving principals, curriculum vice principals, teaching factory coordinators and seven students. Research has revealed that pupils developed their creativity by producing items such as wooden products, and drone and enhanced their entrepreneurship skills by creating startups and selling products online selling. The study's findings suggest that government policies should promote stronger industrial relations and involve industry in designing vocational school curricula to meet national and international industry standards.

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1. INTRODUCTION

One of the today's main education challenges is bridging the disparity between what pupils have learn in class and what they need in real life (Hempen, Wischniewski, Maschek, & Deuse, 2010; Jaeger, Mayrhofer, Kuhlang, Matyas, & Sihn, 2015; Kuhlang & Shin, 2012) as well as the competencies required by the industry and business. To prevail in today's competitive job market, vocational education and training (VET) should involve collaboration with industry and business to foster innovative teaching approaches. A significant challenge for vocational schools is producing job-ready graduates (OECD, 2009). This requires integrating school learning with workplace learning, particularly in VET, to enhance the quality of graduates. In South Korea, for instance, regarding the quality of vocational schools, the government has attempted to increase student interest in VET and better align VET programs, and labor market needs with a series of reforms in the system structure since 2010.

Restructuring of vocational school focuses on certain industries encourages greater collaboration with industry partners. In South Korea, the government has implemented a series of reforms since 2010 to increase student interest in VET and better align VET programs with labor market needs. These reforms focus on certain industries and promote greater collaboration with industry partners. The South Korean government also develops its curriculum in partnership with industrial entities (National Center on Education and the Economy (NCEE), 2018). As a result of these new policies, there have been improvements in the employment rates of vocational school graduates and increased public interest in vocational education (J.-H. Lee & Hong, 2014).

Indonesia faces a similar issue regarding the quality of vocational school graduates, reflected in its high unemployment rates. According to the Central Bureau of Statistics, the Open Unemployment Rate (OUR) for vocational school graduates is the highest among all education levels. In 2017, the unemployment rate for this group was 11.41%, which decreased to 8.92% in February 2018, and further to 8.49% in February 2020 (Badan Pusat Statistik, 2020). This data indicates that there are issues with graduates of vocational schools, which are probably connected to the caliber of the curriculum and learning environment. These statistics highlight potential issues with the vocational curriculum and learning environment. Consequently, the Indonesian government has initiated reforms to revitalize the vocational education system, aiming to enhance the quality of graduates and align their skills with industry demands, similar to the reforms implemented by the South Korean government. Competency-oriented education, which focuses more on work-related or community-specific skills rather than general competencies, can reduce the likelihood of future unemployment (Hoidn & Šťastný, 2023; Wu, Hao, Lv, & Hu, 2022). Teng, Schreiner, and Nelson (2001) the 'Teaching in the Factory' approach, which integrates academic rigor with real-world experiences, benefiting all stakeholders. Indonesia has adopted this approach to improve the quality of vocational high school education.

The Indonesian government has prioritized the Teaching Factory and Technopark programs to revitalize and reform vocational high schools, aiming to produce graduates with ready-to-use skills needed by businesses and industries(Manalu et al., 2017). The teaching factory concept integrated research, education, and innovation, forming a "triangle of knowledge"(G. Chryssolouris, Mavrikios, & Rentzos, 2016; Mavrikios, Papakostas, Mourtzis, & Chryssolouris, 2011). It brings real-world industrial projects into the classroom using relevant educational approaches and ICT configurations to facilitate interaction between academia and industry. This model promotes a two-way knowledge exchange between industry and education (George Chryssolouris, Mavrikios, & Mourtzis, 2013; Rentzos, Doukas, Mavrikios, Mourtzis, & Chryssolouris, 2014; Rentzos, Mavrikios, & Chryssolouris, 2015) and aims to align vocational training with modern industrial practices (G. Chryssolouris et al., 2016). Technoparks, also known as Technology Parks, Science Parks, or Science and Technology Parks (STPs), are organizations managed by specialized professionals to foster economic growth through innovation and competitiveness (UNESCO, 2017). In Indonesia, Technoparks serve as hubs connecting vocational schools with industry and relevant agencies, promoting collaboration with Teaching Factories. They also function as "Think Tanks" for vocational high schools, helping them adapt to rapid industrial changes and leveraging regional potentials for economic development (Khurniawan et al., 2016).

Previous studies have highlighted the positive impact of Teaching Factories and Technoparks on technological innovation and economic development. Teaching Factories benefit both academia and industry through pilot projects (Rentzos et al., 2015), and provide students with practical experience in industrial settings, enhancing their technical education (Teng et al., 2001). Zhang and Sonobe (2011) found that national science and technology industrial parks (STIPs) experienced remarkable growth from 1992 to 2006, with annual real output value per STIP increasing by over 40%, average labor productivity growing more than sevenfold, and the number of companies within STIPs also rising more than sevenfold. Their research indicated that the productivity of high-tech firms, both within and outside STIPs, was positively influenced by foreign direct investment and academic activities of local universities (Zhang & Sonobe, 2011). In South Korea, the success of automotive companies like Daewoo

and Hyundai was attributed to their close collaboration with R&D institutions and active involvement in the STP field (W.-Y. Lee, 2000). These findings underscore the significance of collaboration between industries, academia, and government in fostering national economic development and improving the quality of education for students.

The Teaching Factory and Technopark programs, widely implemented through collaborations between industries and universities globally, are uniquely applied at the vocational school level in Indonesia. This approach aims to revamp the curriculum, enhance graduate quality, and align education with industry needs. The technopark acts as a marketplace for student innovations, linking vocational schools with businesses, universities, and the government. This study investigates the impacts of these programs on student skills, teacher competencies, and broader educational outcomes. Key research questions include identifying student-created products, assessing the programs' contributions to skills and competencies, and examining the challenges faced in their implementation. To delve into the related issues and the purpose of the study, I formulated the following research questions:

1) What products are created by students due to the adoption of Teaching Factory and Technopark learning models?
2) How does the learning model of Teaching Factory and Technopark contribute to the quality of teachers and students' skills and competencies?
3) What challenges and obstacles do the schools have in putting the teaching factory and Technopark into practice?

2. METHODS

2.1 Research design

Some characteristics of qualitative research include data collection based on words from a small number of individuals, and data analysis for description and themes using text analysis and interpretation of the broader meaning of findings (Creswell, 2012). Thus, the study relied on a qualitative approach since the data were described verbally and interpreted from various aspects instead of being in the numerical form and statistical analysis. Research design of a multi-site case study was adopted as four public vocational high schools were the unit analysis of the research (Yin, 2003) and the study researches the program of teaching factory and technopark as a case study (Hancock & Algozzine, 2006).

2.2 Participants

The selection of the schools as research participants was affected by the schools' implementation of teaching factory and technopark program. Since the schools have been running the programs for longer than four years, data were gathered from four public vocational schools in Jakarta, Indonesia, using the purposive sampling technique. The long-term period is also imperative for researcher because the focus of my research is on the results and contributions of program implementation. In addition, the schools were selected to understand the variability in the implementation of the programs and identify the best practices more deeply. The participants include school principals, vice principals who are in charge in curriculum affair, teaching factory coordinators and representatives of 2-4 students in each school.

2.3 Data collection and data analysis

Data were collected through semi-structured interviews and non-participant observations. Prior to school visits, permissions were obtained via phone calls and consent forms. Interviews were conducted with principals, vice principals responsible for curriculum, teaching factory coordinators, and seven participating students. The interview questions, grounded in the theoretical framework of the teaching factory and technopark models within Indonesian vocational schools, addressed program

implementation, products created, impacts on teachers and students, and challenges faced. Interviews, lasting about 30 minutes each, were held at various locations and times. Pseudonyms were used to protect the identities of schools and participants. Additionally, observations were made at an event at the Jakarta Convention Center on February 14, 2019, where further interviews were conducted with participating teachers and students.

Data analysis followed an inductive and iterative approach, drawing meanings from raw data (Creswell, 2013; Stake, 2006). To ensure data trustworthiness and rigor, method triangulation involving observations, interviews, and document analysis was employed. This approach, essential for case studies, utilized multiple information sources to obtain an in-depth analysis (Hancock & Algozzine, 2006). Field notes were cross-checked with recordings for accuracy. Observational, interview, and documentary data were validated, analyzed, and evaluated to minimize bias. Data were classified and coded by themes before interpretation to extract general meanings aligned with the research questions.

3. FINDINGS AND DISCUSSION

3.1. The Products of Teaching Factory and Technopark

The technopark, functioning as a think tank and integrator of teaching factory products at the vocational high school level, differs from conventional technoparks. Although it does not fully adhere to its conceptual model due to various limitations, it successfully embodies the core principles by connecting schools with industry, training, and entrepreneurship. Consequently, it serves as a small-scale prototype of a technopark within vocational schools. This study focuses on the products generated by the teaching factory and technopark programs in four vocational high schools in Indonesia. The students' creative and innovative products, displayed in the technopark rooms of these schools, are detailed in Table 1.

Table 1. The products of Teaching factory and Technopark

Vocational Schools	Start up and the products
A	1. Establishment of five (5) Startups: *Zifflet* and *Fifty-Six Market, plastikind.com, loakan.id and sekolahmart.com* 2. *E-commerce products and schools' needs* 3. *Teaching factory products of* Mechatronics and Industrial Automation. Auto and Light Vehicle Engineering (TKR), Computer Engineering Networks (TKJ) and Multimedia; and Engineering Machining Teaching (TPM)
B	Product Brand Creative wooden and rattan craft and metal jewelry
C	1. A drone without propeller named Bladeless Drone or F-Copter 2. Components such as ESC, motor driver, and motor DC
D	1. Start-up TKJ 36 Techno Park IT (Information and IT Technology), from IT Consultant to Network Designer. 2. Products of Mikrotik RB952Ui-5ac2nD and Ubiquity: UniFi AC LR

3.2. *The contribution and Impact of the Teaching Factory and Technopark program*.

Implementing the teaching factory concept as a model or method of instruction has a significant positive impact on students' competence and abilities. Subsequently, students, in particular, are able to create or develop the items. Here are several interviews on its contribution and impacts.

> *"Well, the program of teaching factory and technopark* ***stimulate our students' creativity and innovation****. When they are facilitated by the schools and taught by qualified experienced teachers, and have good facilities as in real industry, the students will be more motivated and creative. Actually, many students are smart, but when they are facilitated and taught well,* ***they can express their ideas or innovation beyond our expectation****. And at the end, they will have* ***the capability to produce creative and innovative products.*** *That is what we hope for the graduated students. When they work, they become more ready, skilful, and competent and they also know the real condition of industry or business and the ethical standard that they learn at schools such as work ethic, discipline, responsibility, and punctuality. Well, I believe they can compete with other students from university or college graduates." (Principal A, Mr. Tejo)*

> *"By implementing the programs, the students will be accustomed to learning and practicing, as it is the real work condition.* ***Students will be more competent, skilful, and become ready workers, which meet the standard requirements of the industry or business. Not only that, they will have a spirit of entrepreneurship."*** *(Principal B, Mr. Sujana)*

As enhancing students' entrepreneurship is one of the goals of the program, I also checked the school website to ensure the information as it is stated by the coordinator of teaching factory from School B in the following excerpt.

> *"Our school has 20 practice rooms and 10 laboratories; so, the implementation of teaching factory and Technopark* ***produces young entrepreneurs****. And after they graduated from high school, they are likely to have* ***skills and competence to design the products or know how to market the product through online.*** *You can check our website that the students have sold their products online through the website." (Mr. Sandy)*

Similarly, teachers from School C also informed the product promotion and the students' creativity and entrepreneurship.

> *"We did promote and sell product through website; we also use other social media such as Facebook. Technopark provides students the opportunity to* ***produce product every day and create more attractive packaging to improve the selling power****." (Ms. Riana)*

> *"In addition to using the website or through online selling, the exhibition of creative products along with the art performance and job affair activity is another way to promote the product and develop the entrepreneurial skill of students.* ***Such activity results in 187 championship trophies from various fields for one year."*** *(Mr. Donny)*

A principal of school D expressed her idea about the contribution of teaching factory and technopark in following account.

> *"The purpose of the technopark program is to establish a permanent network amongst schools, universities, business, government, and community. Technopark attempts to combine ideas and innovations from the academics and financial capabilities of the business world. By synergizing with business, industry, government, and universities, which have technopark program in their campus, vocational school can have* ***more qualified teachers and students too****. University also helps us and give training to teachers as to develop not only their knowledge about how to start the start up, but also how to run it. Hence, the training either from business/industry, government or university brings a very important contribution for us. If we have more* ***competence and skilful productive teachers, we also will have more qualified students.*** *" (Ms. Alice)*

Likewise, the vice principal adds the information about the impact of technopark program.

> *"In most activities of the technopark program, not only do students exhibit their works in the event, but they also* ***market the products to practice the entrepreneurship skill*** *they have learned at schools. They also practice how to explain the product thoroughly to customers who might be interested to buy their products. In this point, they can* ***improve their communication skill****, which is beneficial when they graduate and work or maybe if they run*

their own business. That is what we hope as teachers, they can learn something that they can practice in real life, not only theory or concepts but also something practical. For us as teachers, ***we become more active and creative in designing our teaching methods*** *too." (Ms. Nita)*

The program of teaching factory and technopark also plays a significant contribution to teachers, especially after they have cooperation with university and industry or business, which provide training for teachers as reported in following interviews.

"For us, as productive teachers, we learn a lot from university lecturers who train us about the start-up, for instance. We learn how to start the business and we ***become more competent and skilful*** *about the courses that we teach to our students. Having cooperation with university to implement teaching factory and technopark is a very helpful, since the lecturers are more knowledgeable, qualified and they have more experiences." (Ms. Mita)*

"We have a class industry and our curriculum is required to be matched with their standards. Accordingly, we ***learn many things*** *such as the industrial standards about the work procedures, the products, the processing products, the machines or other equipment, the management system and working environment in the industry. We must make sure that the students are familiar with all these too, and we have to transfer and transform our knowledge to students. By having cooperation with industry and getting training, we turn out to be* ***more qualified teachers****." (Mr. Pipit)*

Several students that I met during the exhibition also find it essential that the students can apply what they have learned in class.

"I reckon that this event ***brings positive impact*** *to all of us since it enables each student to* ***bring out his/her own creativity and be able to become an entrepreneur.*** *I feel that I become* ***more discipline, responsible and tough.*** *I think I am more competitive now because I have to force myself to create something better. This is a competitive era, right? If we have better, interesting, and more varied products, we can sell more and better." (Devia)*

"We can at least exhibit our works in the event, and introduce our school products to larger community, since many people attend this event from many places and areas. And for those who are interested in enrolling their children to our school, we can also show our competence. Maybe they are interested in our school majors too. At the same time, we promote our school as well. In addition to ***marketing the products and promoting our school, we also practice our entrepreneurship skill*** *that we have learned at schools. I feel enjoyable when being assigned to take part in this event. I also feel proud to study in this school because I learn a lot of things here, not only theory but practical things that I can use it after I complete my study." (Laras)*

"I enjoy a lot this kind of activity. All of us can ***practice how to market the product, explain the product, and practice our communication skill*** *at the same time. At first, I felt quite nervous, and I am afraid that I give wrong explanation, especially, if the customer is so critical and asking too many questions, but my friends help me to answer the question. Our teacher who accompanied us also helps to explain it. Thus, I saw and learned from some of my friends how to explain it too. Now I become more relaxed. One thing for sure is that we* ***can learn not only at school but also at industry or business****." (Jimin)*

"It is not only beneficial and useful for us, but we can directly relate our lesson and knowledge to the real working condition. Hence, when we graduate, we ***become ready workers,*** *right! And we can* ***get job more easily*** *since we have more experiences or if we have capital to* ***run business****, we know how to do it." (Gyana)*

"For me, from this event I can ***interact directly to customers****. This event also makes me have more willingness to get more money (laughing quite hard). I learn a lot, I think, at school. For example, I learn* ***how to design*** *the products, which make me* ***more creative****. The teachers also teach and give a lot of examples and guide us. The most important thing is that I can practice my hobby,* ***develop my skill*** *and at the same I can earn money with my hobby. Now I sell some of my own product from my creation to my neighbours and my friends." (Deddy)*

Two other students also give comments when I ask about how they feel taking part in the events and what they think about teaching factory and technopark.

> *"I major in fashion, so teaching factory can make me **become more creative and inspire me** a lot. For example, we can use fashion up-cycle products by using reject items in the market but with good material. By having help from the teachers, we can also **know good materials and how to choose it and use good material** without spending much money. Since I like fashion, I can design my own clothes now and I change my old clothes to be new ones with some new added materials." (Malika)*

> *"It is good to **learn something practical**, besides we get knowledge from our teachers, we can practice it directly, our school is designed as like a real industry or business. So at least, when we work later, we will be **more familiar with the real condition and environment**." (Jafta)*

3.3. The challenges and The obstacles

Three findings can be drawn about the difficulties and challenges encountered by schools, teachers, and students when putting teaching factories and technoparks into practice. Based on interviews with teachers and principals, vocational high schools face a number of challenges and obstacles in implementing the Teaching Factory and Technopark, including limited budget, lack of marketing access, age gaps between senior and junior teachers, lack of facilities, tight competition, and a lack of competent and productive teachers. Moreover, one of the main issues facing schools today is forming partnerships with business and industry.

The technopark manager claims that among the challenges teachers encounter are not having enough time to coordinate the efforts of teachers in charge of Technopark management and not being able to devote enough attention to managing technopark because of the numerous teaching and learning activities. The lack of training in start-up knowledge, the lack of human resources to support students' start-ups, and the lack of hours or time to manage and promote the start-up products are the main obstacles for students.

Discussion

This study investigates the impact of technopark and teaching factory implementations on the skills and competencies of teachers and students, highlighting the challenges faced by schools, educators, and learners. These programs, which foster innovation through knowledge and technology transfer across sectors, are crucial for successful educational transitions. Table 1 illustrates that schools implementing these programs stimulate student creativity and innovation, producing products aligned with their vocational competencies and improving student quality. The teaching factory and technopark practices align with Kolb's experiential learning model, emphasizing the development of fundamental knowledge and skills through practical application. This experiential pedagogy, based on constructivist and socio-constructivist paradigms pedagogy (Dewey, 1998; Lobler, 2006), is more effective in developing entrepreneurial competencies compared to traditional methods, which are better suited for teaching entrepreneurship theory (Kozlinska, Rebmann, & Mets, 2023). Kolb's model (1984) emphasizes learning through action and reflection, reinforcing the benefits of experiential learning (Kolb, 1984; Kozlinska et al., 2023).

In most activities of the teaching factory and technopark program, it can be summarized from interviews on the contributions to students, such as improving students' creativity, innovation, entrepreneurship skills, communication skill, and attitude changes. For schools, they can establish a permanent network amongst schools, universities, business, government, and community. The teachers will become more knowledgeable, competence, skilful and master their subjects holistically. The purpose of the technopark program is also to establish a permanent network amongst schools, universities, business, government, and community, which technopark attempts to combine ideas and innovations from the academics and financial capabilities of the business world. The event, which brings positive impact since it enables each student to bring out his/her own creativity and be able to

become an entrepreneur. This is in line with expert opinion that to improve the techno-parks management system, increasing the effectiveness of research and innovation activities, and the commercialization of the results obtained is very necessary for the development of a science-based economy (Klyucharev, Tyurina, & Neverov, 2017).

This current findings are related to some of the findings indicating the positive impact of the implementation of the teaching factory and technopark, including benefitting the companies by bringing fresh engineering minds, increasing technical knowledge, team skills, and real-world experience of students (Teng et al., 2001), increasing students' achievement motivation (Amar, Hidayat, & Suherman, 2015). Lamancusa and Simpson (2004) highlighted that 1) students can apply their theoretical knowledge to the real-world problems; 2) the learning model can improve common sense and judgment; 3) learners learn to collaborate with people of all levels; 3) students can broaden their appreciation of different disciplines; 4) they also learn from their own mistakes and failures; and 5) they discover that everything usually takes longer and costs more than expected. Furthermore, factory learning and innovation promotes the learning environment in order to develop learners' professional and social competencies, as well as to establish novel platforms for shared knowledge (Jaeger et al., 2015). Moreover, the teaching factory can help students understand not only methods but also hands-on experience that can provide real access to applying methods such as in real life businesses and they can train and reflect on their knowledge before entering the world of work. The success of the Cal Poly teaching factory demonstrated an impact on several aspects of regional manufacturing, include: 1) produce more highly educated engineers; 2) Students from all throughout California will have interesting opportunities to master manufacturing skills and pursue rewarding jobs in the sector; and 3) Companies in the region will discover skilled and eager graduates with superior equipment to meet current industry problems and contribute to their success (Alptekin, Pouraghabagher, McQuaid, & Waldord, 2001).

The teaching factory scheme allows students to deepen certain topics of knowledge and apply them in practice, in the actual deadline; their work will have a real impact outside the academic environment. From an industry point of view, teaching factory provides ideas and solutions that will not be considered during standard enterprise processes to solve the problem. Factory workers will also have the opportunity to interact with a group of students with new ways of thinking and problem-solving capacity. Even in some cases, some students approach problems with their real talents and their out-of-the-box thinking (Rentzos et al., 2014). Thus, synergies and benefits will occur together with schools, students, and industry. Henriksen and Mishra (2015) in a study of teacher creativity observed significant shared patterns across successful and creative teachers, such as incorporating real-world learning into courses and activities; taking intellectual risks and encouraging students to try new things; and providing cross-disciplinary learning experiences. The collaboration of government, university, and industry sector is imperative to boost students' innovation and creativity and to develop their entrepreneurial skill. The universities' task is to provide training and to mentor teachers and students and connect schools to industrial and business network access. For example, the students are taught soft skills such as personal recognition, communication, habits, and attitudes at works, and collaboration, which are highly needed at the workplace. It implies that the practice of teaching factory builds students' soft skills and competency. In term of soft skill, students can understand the real condition of the working environment, the etiquette, the working habits, management, and the relationship between subordinates and employers and colleagues.

In addition, mentoring provided by higher education resulted in improvements in management, administration, and production and developed teachers' knowledge and quality. In terms of creativity, the role of the environment in encouraging creativity, as well as the ways in which educators can influence the environment to foster creativity in their students, are critical (Abdulla & Cramond, 2017). It means that the individual's creativity can be strengthened, enriched or developed by exploring, creating, and attempting novel things (Henriksen & Shack, 2020). The study literature advocates that mentoring new instructors can enhance their professional skills and help them acquire self-confidence

(Kidd, Brown, & Fitzallen, 2015). Prior study indicated that mentoring activities are beneficial to participants, bring them satisfaction, and have the power to motivate them to engage with students in the classroom (Fitriani & Ilyas, 2021) and have a good impact on teachers' pedagogial, professional and emotional domains (Hudson, 2013).

The teaching factory and technopark program stimulated not only students' collaboration skills, critical thinking skills, creativity, and communication skill as the components of the 21st century's 4 C's skills (Trilling & Fadel, 2009), but also their characters and citizenship (Fullan & Scott, 2014), which becomes 6C's skills. The collaboration of three sectors (Academic, Business, and Government) known as a triple helix was firstly introduced by Etzkowitz and Leydesdorff. The synergy of three sectors helps the vocational schools to generate ideas, creativity, and innovation. Every helix idea plays a role and has different interests to encourage innovation, called the Triple Helix effect (Etzkowitz & Leydesdorff, 2000; Ranga, Miedema, & Jorna, 2008). In the triple helix concept in vocational school, the triple helix model implemented in vocational schools is different from the one carried out in higher education as the initial concept of the triple helix, where the roles of each sector/actor are described in Figure 1 (Khurniawan et al., 2016).

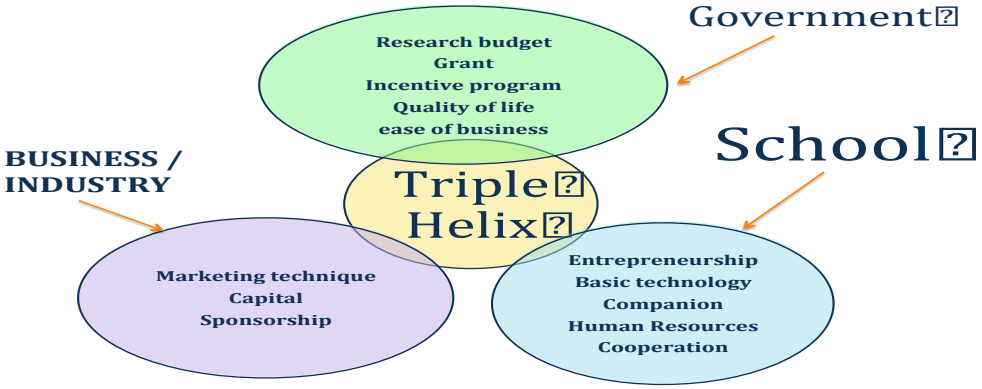

Figure 1. Triple Helix at Vocational School

In the triple helix model used in vocational schools, each actor plays a distinct role that works in concert with the others to successfully execute the teaching factory. Previous studies have shown that ideas of triple helix proves the beneficial effects of various forms of collaboration (Etzkowitz, 2014; Etzkowitz & Viale, 2010; Fitriani, Wahjusaputri, & Diponegoro, 2019, 2020; Leydesdorff, 2012). Their collaboration results in knowledge distribution, which leads to innovation as well (Herliana, 2015). The technopark of vocational school seeks to combine ideas, innovations, and know-how from various teaching factory of vocational schools and financial (and marketing) capabilities from the business world. Vocational implementers can learn and visit each other (best practice) and share their knowledge and experience by conducting joint seminars, bazaars, or exhibitions that can be funded together or in collaboration with industry and local government whose purpose is to introduce the results of their products to the community. It is expected that this merger can increase and accelerate product development and reduce the time needed to move innovation to marketable products, with the hope of obtaining a high economic return.

This study offers several implications for students, teachers, schools, and educational policy. For students, participating in teaching factories provides practical experience in a simulated industrial environment, bridging the gap between theoretical knowledge and real-world application. This hands-on approach enhances comprehension and retention of concepts, equips students with relevant skills for their chosen fields, and improves their employability. Additionally, it encourages critical and creative thinking, fostering problem-solving abilities essential for any profession. Teaching factories

also enhance student motivation and engagement by making the curriculum more interactive and relevant to real-world situations.

For teachers and schools, the implementation of teaching factories involves resource intensiveness, curriculum integration, quality assurance, evaluation, assessment, and scaling challenges. Policymakers need to collaborate closely with vocational schools to develop standards and curricula that incorporate industrial instruction. They should also promote partnerships between vocational schools and local businesses to support teaching factory initiatives, possibly offering tax incentives and other benefits to encourage industry involvement.

Policymakers must invest in teacher training programs to ensure educators possess the skills and knowledge to effectively implement teaching factory methodologies. This could include workshops, seminars, or certification programs focused on project-based learning and industry-relevant skills. Furthermore, policymakers should support research projects to identify best practices and evaluate the efficacy of teaching factory models. This could involve funding scholarly investigations, forming research collaborations with vocational schools, or organizing conferences and symposiums to share knowledge and foster innovation in vocational education.

4. CONCLUSION

The current study demonstrates that implementing the teaching factory model in vocational schools fosters self-reliance and entrepreneurship among graduates while promoting innovation through joint projects with industry. This integration of teaching factories and technoparks represents a significant advancement in educational practices, offering students immersive learning experiences that bridge the gap between theoretical knowledge and practical skills. By engaging students in real-world projects, these models enhance problem-solving, critical thinking, creativity, and industry-relevant competencies. Despite challenges such as resource allocation, limited marketing access, budget constraints, and a shortage of competent teachers, the benefits of these programs outweigh the drawbacks. Collaboration among policymakers, administrators, universities, and industry stakeholders is crucial to securing the resources and support necessary for the success and sustainability of these initiatives. As vocational high schools evolve, the focus on fostering innovation tailored to regional potential is expected to improve graduate quality and drive regional and national economic growth. Key factors for successful implementation include the school's capacity to apply the learning model, teacher preparedness and skills, facility availability, and the principal's ability to create strategic plans. However, this research has limitations. It focuses on four public schools, making generalization to private schools difficult. The predominantly qualitative methodology could be complemented by quantitative approaches for greater accuracy. Additionally, examining long-term effects, such as graduates' workforce success and the sustainability of industry partnerships, would require more extensive research over a longer period. Future studies should explore these aspects.

Acknowledgments: We are indebted to Lemlitbang, Universitas Muhammadiyah Prof. DR. HAMKA, which financially supported the research.

Conflicts of Interest: No conflict of interest was reported by the author.

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