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Utilizing learning factory as enabler to TVET goals: Students' learning experience

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Abstract

One of the practical means of attaining sustainable development is Learning Factory (LF). Learners in Higher Education Institutions (HEIs) can build their essential competencies in a real-world setting within the LF setting. This article's goal is to examine the value of LF in HEIs and the suggested expansion of LF in HEIs to achieve TVET goals. One issue facing industry around the world is a lack of skilled workers to meet emerging industry requirements. This issue requires the educational content and didactical methodologies improvement. However, many universities are not applying teaching and training techniques that ready students for industrial employment. The learning factory concept can be introduced to the institution as a means of resolving this problem. This is because the learning factory technique incorporates business activities into the educational process. This study examines the advantages of applying the learning factory concepts based on a Malaysian public university experience. Open-ended questions were given to 63 students who had used the learning factory. This study revealed three key advantages, including increased learning process interest, student hands-on experience based on genuine industrial job life, and improved lecturer to student knowledge transfer. Findings from this study can assist instructors, lecturers, or higher education institution management in coming up with new ways to make the process of imparting knowledge to students easier and more engaging, and at the same time supporting sustainable development goals. Future research may investigate the connection between teaching techniques and their academic success.

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1. Introduction

One of the issues the industry sector faces globally is a shortage of skilled workers to handle emerging industry problems. Shorter product lifecycles, shorter lead times for deliveries, greater levels of product personalization, greater product variety, and greater expectations for product quality, but at a significantly lower market price, are just a few of the new industry challenges [1]. To satisfy the present and future demands of the manufacturing industry, this transition necessitates improvements in both the educational content and didactical methodologies.

The competencies required to work in the manufacturing industry are not continuously delivered through the teaching and training techniques now utilized in tertiary education and higher learning institutions [2]. Universities continue to use the conventional methods of teaching in the classroom, such as using images, videos, lab exercises, or case studies to instruct students about the manufacturing processes [3]. Young university graduates are finding it difficult to adapt their life to the new working environment after they graduate. Thus, developing new approaches to train the future employees to be able to adapt to the industry's work life and expectations is highly needed. One method is the implementation of the learning factory concept, which emphasizes the development of students' competencies through experiential learning.

“A learning factory is defined by processes that are authentic, include multiple stations, and comprise technical as well as organizational aspects, a setting that is changeable resembles a real value chain, a physical product being manufactured, and a didactical concept that comprises formal, informal and non-formal learning, enabled by own

actions of the trainees in an on-site learning approach” [4]. Learning factory is a strategy that incorporates business practices into the educational process. The goal of this integration is to create learning settings that may give students more practical, hands-on experiences. In this approach, the teaching staff and students can be exposed to some of the most recent manufacturing techniques, technological advancements, fashion trends, and research endeavors from a classroom setting to a factory process and vice versa [5]. For instance, students can receive instruction in problem analysis or product development and delivery that can be applied in a real-world teaching and learning setting [6]. Through university-academia collaborations, such a learning strategy can close the gap between industry requirements and academic delivery methods [7]. This effort is crucial because many recent university graduates lack actual work experience, especially when it comes to applying technical knowledge [8]. Studies that examine how learning factories can aid in the development of skills needed by the sector are still limited, but [9]. Consequently, this study will investigate the advantages of applying the learning factory concepts based on the work of a Malaysian institution.

2. Learning factory at Universiti Malaysia Pahang

In 2016, the Faculty of Industrial Management at Universiti Malaysia Pahang began to consider creating a "learning factory." It was initiated by a group of lecturers with the goal of exposing faculty students to real-world workplace experiences and factory processes. The learning factory was set up in 2017, and it began operating in September of that same year. Participatory action learning serves as the didactic underpinning for the Learning Factory. As a result, everyone in the learning factories, including instructors, students, and researchers, will actively participate in identifying and resolving real-world problems. Lean manufacturing was initially selected as the pilot project subject, and classes were split into two parts: classroom lectures and lab work in the learning factory. The class lecture that the students must attend will serve as an introduction to the topic. The purpose of this is to give the pupils the necessary academic understanding of theory, tools, and concept of lean used in the industry.

The pupils would then use the lab to complete the assignments given to them at the learning factory. Each group had five to six pupils in it, and they were split up into smaller groups. The activity in the learning factory was divided into 2 sessions with each session having between 30 and 32 pupils because the class had 63 students enrolled. The students were given tasks in accordance with the syllabus, and they are supposed to use the knowledge they have learned in class lectures to address important business problems. At the conclusion of each lesson, the results of their research were presented to the class. This is to enable the students to experiment with the technology while using the learning factory as a platform to test their understanding. Concept that can be used in the learning factory is shown in Figure 1

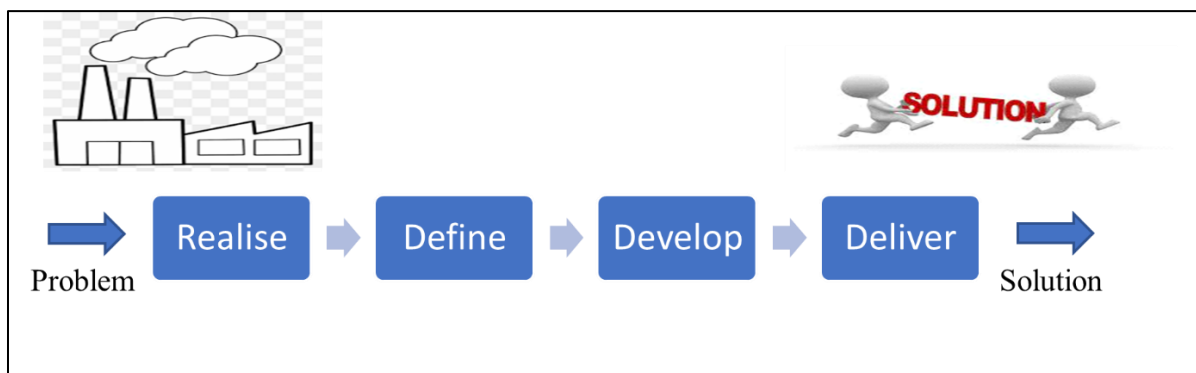


Fig.1. Learning factory framework



Fig. 2. Learning Factory facilities

The learning factory resembles a supply chain processes which comprise of a few sections such as the warehouse, a manual assembly line process, inspection processes, packaging processes, and a small fabrication workshop. The process layout uses a flexible, changeable, and reconfigurable production system so that it can be easier for the students to setup and dismantle the process. Refer to Figure 2 for the learning factory.

3. Methodology

This study was carried out during the first semester of the 2022–2023 academic year in the lean manufacturing course. A total of 63 students, all senior students in their third or fourth year of the bachelor's degree in industrial technology management program, are involved in this study. The quizzes, tests, and group projects were used to evaluate the pupils' understanding of the subject. Whereas all the group projects assessment was based on their performance in the learning factory activities. To get the response from the students about their experience working in the learning factory, an open-ended survey form was given to them at the end of the semester. All students were required to give their opinion regarding their experience in using the learning factory.

4. Result

When students were asked about the benefits of using the learning factory, the following result were received. Refer to Figure 3.

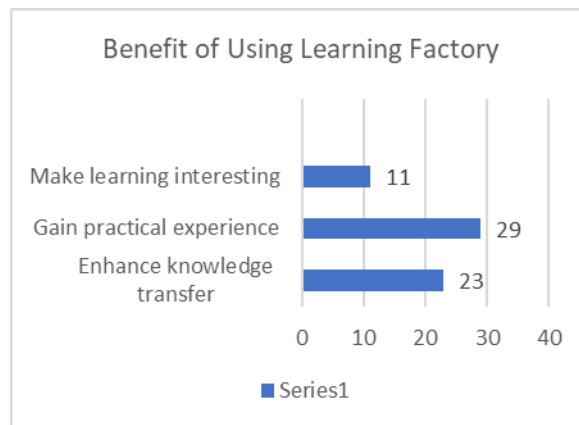


Fig. 3. Student's response

Most students responded that using Learning Factory allows them to obtain practical experience when asked about its benefits. Enhancing information transmission and making the learning process entertaining come next. Some of them assert that by really carrying out the procedure, it improves their memory and enables them to connect the theoretical concept with the practical application of what they have learned in the classroom. Likewise, participants asserted that they were able to learn new things through the practical exercises, which increased their confidence as they prepared to enter the job market after graduating from college.

Additionally, the students were asked if using the learning factory can help to improve their soft skills. The result indicates that 96.8% of the students have agreed that the learning factory's activities had improved their soft skills.

Teamwork, decision-making, problem-solving, time management, leadership, and communication abilities were among the soft skills that they claim have improved after using the learning factory.

5. Discussion

This study investigates the benefits university students perceived after using the learning factory facility in the university. Findings from this study may assist instructors, lecturers, or higher education institution management in coming up with new strategies for making the process of imparting knowledge to students more engaging and simpler. More importantly, the work done in the learning factory helps to close the gap between the theoretical and practical sides of the knowledge transfer process. This is crucial because Technical and Vocational Education Training (TVET) needs to increase the supply of capable new workers to join the industry. As a result, HEI leaders should work together to produce a skilled workforce for inclusive sustainable development, particularly for technologically underdeveloped nations such as Malaysia to ensure they have a bright future and can meet their sustainable development goals. Even though the concept of teaching by using learning factory is new especially under the context of Malaysian education system, more studies should be made to understand the effectiveness of its implementation towards producing highly capable workforce to the industry.

6. Conclusion & recommendation

Three advantages of employing Learning Factory in a university have been highlighted by the study. First, it adds interest to the learning process. Second, learning factory activities provides students a taste of what it's like to work in the real world. Third, a learning factory can improve the knowledge transfer process. Future research should investigate the connection between teaching student's factory techniques and student performance. The sample size can be increased to do this. Students taking the industrial technology management course can be used to participate in this study. Maybe this research can be expanded to include engineering and other technological disciplines students in the study.

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References

- [1] B. Abdelilah, A. El Korchi, M. A. Balambo, Flexibility and agility: Evolution and relationship. *Journal of Manufacturing Technology Management*, 29 (2018), 1138–1162.
- [2] M. Ghazali bin. Maarof, Applying Learning Factory in Lean Management: The Experience of Undergraduate Students in a Malaysian Public University. *Conference.Kuis.Edu.My, 2020 (ICoMM)*, 2756–8938.
- [3] J. Cachay, J. Wennemer, E. Abele, R. Tenberg. Study on Action-Oriented Learning with a Learning Factory Approach. *Procedia - Social and Behavioral Sciences*, 55 (2012), 1144–1153.
- [4] E. Abele, Learning Factory. In *CIRP Encyclopedia of Production Engineering*, 2019.
- [5] D. Mavrikios, K. Georgoulas, G. Chrysolouris, The Teaching Factory Network: A new collaborative paradigm for manufacturing education. *Procedia Manufacturing* 31 (2019), 398–403.
- [6] K. Lindvig, H. Mathiasen, Translating the learning factory model to a Danish vocational education setting. *Procedia Manufacturing*, 45 (2019), 90–95.
- [7] M. R. Darun, A. S. Al Adresi, J. Ali, M. G. Maarof, Integrating blockchain technology for air purifier production system at FIM learning factory. *Article in International Journal of Control and Automation*, 13 (2020), 1112–1117.
- [8] N. Khalid, N. Abd Hamid, R. Sailin, Importance of soft skills for industrial training program : Employers' perspective. *Asian Journal of Social Sciences & Humanities*, 3 (2014), 10–18.
- [9] J. Mateo, J. A. Yagüe-Fabra, Public-Private Collaboration Learning Factory Project for Soft Skills Training in Engineering, Vocational Education and Training and Executive Programs, *SSRN Electronic Journal*, (2021).