

## STUDENTS EXPERIENCE USING LEARNING FACTORY AT THE FACULTY OF INDUSTRIAL MANAGEMENT

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**ABSTRACT** – One of the issues faced by the industry internationally is a lack of skilled workers to meet growing industrial demands. To satisfy the demanding requirements of the manufacturing industry in such a scenario, both the educational content and didactical methodologies need to be enhanced. However, the university and other higher education institutions do not currently use training and teaching strategies that prepare students for employment in the industrial sector. The learning factory concept can be introduced to the institution to resolve this problem. The learning factory technique mixes business activities with the educational process. This study evaluates the student's perception in using the learning factory concepts at the Universiti Malaysia Pahang, a Malaysian public university located in Pahang, Malaysia. A qualitative research method was employed, and data was collected by interviewing six undergraduate students who had used the learning factory for their lean manufacturing subject. The interview took place at the end of the semester using a structured, open-ended interviewing questions technique. According to the study, the learning factory has four primary advantages which are increase students' interest in TVET topics, boost their level of soft skills, increase their comprehension, and offer tools to help them retain knowledge. The findings of this study can be used to provide new suggestions for lecturers, instructors, or higher education institution administration on how to make teaching students simpler and more engaging using learning factory concept. Future research should study the relationship between learning factory infrastructure, instructional approaches, with student performance.

### ARTICLE HISTORY

Received: 16-8-2023

Revised: 21-8-2023

Accepted: 28-9-2023

### KEYWORDS

*Learning Factory*

*Knowledge Transfer*

*Lean Manufacturing*

*TVET*

## INTRODUCTION

One of the urgent issues facing the industrial business today is the unprecedented lack of competent workforce to tackle the current and new industry problems. The rise of new technology especially in the current manufacturing industries is among the key factor that caused this concern. As a result, reskilling these industry workers is needed in order to keep them up with the changes in the manufacturing technology or practices. This situation are also caused by the fact that majority of the manufacturing processes are still depending on manually operated technology (Abele, 2019). If this issues are not handled carefully, it could have detrimental effects on the future expansion of the manufacturing business. However, there is no quick fix for this skilled worker crisis. This is due to the possibility that a mixture of the education teaching and training method, and changing workers' attitudes towards industrial working practises may be necessary to address a skill deficit in the workforce (Maarof, 2020).

The current teaching and training methods used in the tertiary education and higher learning institution seems insufficient to prepare young university graduates with the required competencies to work in the manufacturing industry (Syamsudin & Shiyu, 2018); Ma'dan et. al., (2019). There seems neither the demands of the labor market nor the advancements in manufacturing technology that is not adequate to kept abreast with the current method in delivering the education and training programs (Nadarajah, 2021; Abele, 2017). In fact, many of the traditional training techniques were based on the normal classroom lecture or lab work which could only partially effective in fostering student interest towards learning competences needed in the industry contexts (Mavrikios et. al., 2019; Cachay et. al., 2012). Furthermore, academic achievement is often considered to come first, and often thought of as the criteria that will increase students' employability and performance. Unfortunately, some companies have acknowledged that acute shortage of soft skills competencies among many young university graduates and current industry workers are happening at a very distressing level (Ma'dan et. al., 2019). Failing to address such issues effectively can cause companies great impact to industry as special training or re-skilling programs will be needed to train these workforces before they are allowed to work in the industry.

The current approach of teaching and learning used by several higher education institutions (HEIs) leads to Malaysia's poor graduate employability rate (Nazron & Nga, 2017). These HEIs continue to teach students about manufacturing procedure by using the traditional lectures method that could sound bored and dull (Lindvig & Mathiasen, 2019). Other higher education institutions might utilize illustrations, movies, lab work, factory visits, or case studies to

expose their students to the manufacturing processes. These methods may have been successful in the past, but most graduates will require further training to prepare them for the industry's genuine challenges. In order to help young graduates adjust to the working world, they should be given the chance to learn about and experiment with difficulties, then solve them using the current procedures used in real industry. Having said that, the majority of employers are now seeking young graduates how to possess skills that can thrive in today's demanding and cutthroat business environment. Advantage will be to those who can demonstrate a high level of soft skill expertise and able to adapt smoothly to the demand of the industry (Skritsovali, 2023). Therefore, there is a very serious gap between what is being produced by the HEIs with what is expected by the industry practitioners on these young university graduates.

Therefore, there is a new teaching and learning approach known as the Learning Factory technique. This innovative method of instruction is ideal for preparing students, particularly for TVET courses (Mat Jam & Puteh, 2020). Learning factory methodology is a form of experiential learning approach where students can experience a realistic manufacturing environment for education, training, and research. Currently, there are numerous learning factories that have been constructed in both the academic and industrial sectors (Abele, 2015). Majority of the learning factories setup worldwide were used to teach students for the lean production related subjects (Metternich, 2021). Through the integration of industrial projects and activities in the learning factory, students will be able to develop technical skills and knowledge through hands-on learning experience (Baena et al., 2017). There are several factors that trigger this rising interest in using learning factory for teaching and learning in the educational contexts. For instance, research indicates that students' enthusiasm and comprehension of the subject have increased as a result of their hands-on learning experience through the learning factory activities (Maarof, 2020).

It is critically necessary to create new training methods that will enable future workers to adjust to the work environment and demands of the industrial sector. A very promising approach to assure these required capabilities can be developed among university graduates through the use of a learning factory model (Schallock et al., 2017). The Learning Factory model might provide a solution to the industry's problem of skills gap. This is because the learning factory strategy can assist recent graduates in acquiring the required industrial skills while they are still enrolled in college. Learning Factory emphasizes strengthening students' competencies through hands-on instruction that is based on real industry practices (Lindvig & Mathiasen, 2019). Therefore, this research work is designed to explore the experience of a group of students who have used learning factory in their Lean manufacturing course. The study was conducted in a learning factory facility located at Universiti Malaysia Pahang. Data was collected based on the students' feedback and experiences through structured interview session. All the participants in this study were gathered among those students who had experience using the learning factory during the semester. All interviews were conducted at the end of the semester after all the students had completed the syllabus. Therefore, the author hoped that this study will serve as a guide for other HEIs as they design a plan to adopt the learning factory approach at their institution.

## LEARNING FACTORY CONCEPT

A learning factory is a concept that combines formal, informal, and non-formal learning to teach students about processes through the use of environments that imitate a genuine, adaptable, and authentically made real physical product (Darun et al., 2020; Centea et al., 2019). Figure 1 illustrates the operation of a learning factory as introduced by Abele et al. (2015).

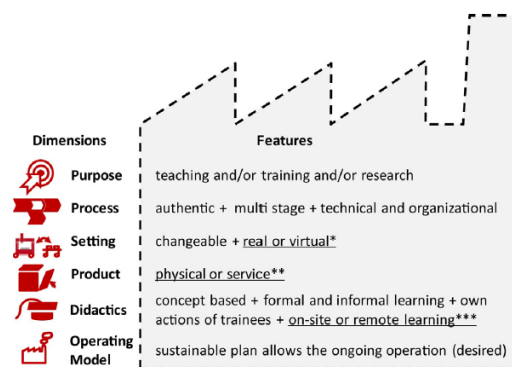


Figure 1. Learning Factory Model

Learning factory concepts can be implemented in a lot of different ways. Generally, the primary purpose of learning factories is "Learning" in a "Factory" environment. A practice-based engineering curriculum that balances analytical and theoretical knowledge with manufacturing skills and hands-on experience in the design of manufacturing systems and product realization are some examples of how to develop a learning factory concept. The core of learning factory concepts is to have a high degree of contextualization (close to real factory environments) and the ability of the trainees to have hands-on experience with what they are supposed to learn via participatory action learning.

The preparation of a platform for educators to rethink and create teaching and learning settings that focus on both teacher, management, and student participation are much needed. People who wish to learn through undertaking tasks

that critically force them to reflect their own experience through group discussion, trial and error, discovery, and learning from and with each other are said to be engaging in participatory action learning (Zuber-Skerritt, 2002). It is important that in participatory learning, students or learners should be given the chance to practice more hands-on skills within a learning factory facility that is close to reality in the industry. In this approach, students can incorporate real-world industrial practises into their classroom learning experience.

Through learning factory approach, teaching staff and students can be exposed to some of the most recent manufacturing techniques, technology, or trends. In addition, some research findings can be transferred from a classroom setting to a factory process and vice versa (Mavrikios et. al., 2019). This effort is crucial because many recent university graduates lack actual work experience, especially when it comes to applying technical knowledge (Centea et. al., 2020; Khalid et. al., 2014). More studies are needed to study how learning factories can support the development of skills needed by the manufacturing sector (Mateo & Yague-Fabra, 2021).

## LEARNING FACTORY FACILITY AT UNIVERSITI MALAYSIA PAHANG

A learning factory was first set-up at the Faculty of Industrial Management at Universiti Malaysia Pahang in 2017. Lean manufacturing was initially chosen as the subject for the pilot project. Students were taught on using and understanding lean tools based on both the theoretical classroom and hands-on activity in the learning factory. Assignments were given to the students in the form of small group projects in which they are required to come up with possible solutions using the facilities provided in the learning factory. Figure 2 presents the facilities in the learning factory.



**Figure 2.** Facilities in the learning factory

To simulate an actual manufacturing process, a learning factory that resembles a supply chain method has been constructed making it to appearance like a mini factory. Various manufacturing processes were included such as the production workstations, material warehouse, and packing process. A flexible, interchangeable, and adaptable production platform with majority of the equipment were designed and constructed to make it easy for the students to set up and dismantle the process later.

In order for them to learn from one another and receive comments from their lecturers, students were invited to explain their findings to their colleague. Assignment in the form of small group projects is given to students to help them understand and relate what they have learned during class lecture. At the same time, the students can experience using the manufacturing technology as the use the learning factory facility enables them to test and improve their level of understanding. The students were given a project at the end of the semester to develop a solution to a particular scenario that was based on actual industry problems. Figure 3 shows the activities conducted in the learning factory.



**Figure 3.** Activities in the learning factory

## METHODOLOGY

This research was carried out in the lean manufacturing course during the first semester of the academic year 2022-2023. The lean manufacturing course was taught using a variety of teaching and learning techniques, including case studies, class lectures, and exercises in the learning factory. During the lecture, the lean principles and tools were explained to all of the students. The students were given the opportunity to work on a few projects in the learning factory after going through a number of classroom lectures. Students were requested to work in smaller groups in the learning factory. Due to the capacity restriction in the learning factory, the students were divided into groups of between 6 and 8 persons, and they are required to complete their duties there.

The interviewees were chosen among six students who had used the learning factory. These individuals were all enrolled in the Industrial Technology Management Bachelor's Degree programmes at Faculty of Industrial Technology Management, Universiti Malaysia Pahang. In order for them to still retain their recent memories on the new educational experience at learning factory, the interview was conducted at the end of the semester. To encourage the acquiring of the essential input about the students' learning experience, the researchers organised an open-ended interview questionnaires session. Before the interview session were conducted, each question was checked and validated by two academicians. All participants were reminded that there are no right or wrong answers to the interview questions, and participants were assured that their names will remain anonymous. This is to ensure that they will give their sincere answer to all the questions. All responses were recorded and subjected to thematic analysis. The participant demographics are displayed in Table 1.

**Table 1.** Participant Demographics

Participant No.	Sex	Seniority
Participant 1	Female	3 <sup>rd</sup> .year student
Participant 2	Female	3 <sup>rd</sup> .year student
Participant 3	Male	3 <sup>rd</sup> .year student
Participant 4	Male	3 <sup>rd</sup> .year student
Participant 5	Female	3 <sup>rd</sup> .year student
Participant 6	Female	3 <sup>rd</sup> .year student

A set of question were asked to all the participants. The following are the questions being asked to the participants.

- 1) What is your opinion on the activities conducted in the learning factory?
- 2) Can you explain how does the activities in the learning factory helped you in your learning process?
- 3) How do the activities in the learning factory help you to bridge theoretical concepts and practical application?
- 4) How much has your soft skill improved after going through few sessions in the learning factory?

## RESULTS

All the respondents gave positive responses to the activities conducted in the learning factory. According to them, the use of a learning factory increased their interest to the subject. The participants further elaborated their opinion about the use of learning factory during lean manufacturing class. Their responses were recorded as below.

“We can experience real simulation in the production process while doing the activities. Interest to the subject can be developed from the activities being conducted”.

Participant 5

“We can apply what we have learned in the class lecture during activities in the learning factory, making the learning process to become more interesting. This gives us some exposure to the industry practices before we enter the job market”.

Participant 3

The utilisation of the learning factory has also improved student comprehension while they are learning. It makes it possible for them to relate a theoretical idea to a real-world application of what they have learnt in the classroom. Participants claim that the practical activities allowed them to learn new things and gave them more confidence to approach the job market. Based on the following participant input, this was brought up.

“Every tool and learning material that we used in the learning factory help to make us more understanding and confident about the subject”.

Participant 1

“The activities in the learning factory enable us to try and visualize the physical appearance of the tools used in the industry. This can help us to understand the material that we have learned during class lecture”.

Participant 2

“The facilities and activities in the learning factory enable me to understand better about the types of wastes in lean. I was able to see myself the kind of waste that happened in a production line and able to take necessary action to eliminate its occurrence”.

Participant 4

Some of participants claimed that the use of learning factory can help them to retain what have been learned in the class lecture as well in the learning factory.

“The activity in the learning factory helps me to remember the topic that I have learned during class lecture and in the learning factory. This is because by doing practical activity, I can remember all the important points in the subject and facilitate learning experience in the classroom”.

Participant 6

Additionally, the participants were asked if using learning factory help to improve their soft skills. The result indicates that learning factory's activities improved their soft skills particularly in teambuilding, decision-making, problem-solving, time management, leadership, and communication skills.

“Activities in the learning factory allows me to meet a lot of people from other classes and we communicate about the project, and it improves my soft skills”.

Participant 1

“My soft skills have improved by discussing with teams, collaborate with others student regarding the practical sessions in learning factory and method that can be used to solve the problems and risk that can be occurred”.

Participant 4

## DISCUSSION

This study explores the experience of a group of students who have used learning factory in their Lean manufacturing course. Result of the study indicates that learning factory concept helps to increase students' interest in learning the technical subject, facilitate their level of understanding, help retain what have been learned in the class, and improve their soft skills. The results of this study can help lecturers, instructors, or higher education institution management to develop new ideas on how to make students more interested to learn Technical and Vocational Education Training (TVET) subjects. The work done in the learning factory also contributes to bridging the gap between the theoretical and practical aspects of knowledge transmission particularly in TVET. Even though the idea of teaching through the use of a learning factory is novel, particularly in the context of the Malaysian educational system, more research is needed to determine how well it actually works in the real practise.

## CONCLUSION & RECOMMENDATION

Four advantages of employing Learning Factory in a university were highlighted in this study. First of all, it adds interest to the learning process especially on the technical subjects. Second, learning factory activities provide students a scenario of what it is like to work in the real world, thus, facilitate their understanding on how to apply the knowledge they have learned. Third, through practical activities, it helps students to practice and retain what have been learned in the class and learning factory. Finally, learning factory enable the students to enhance their soft skills that will be needed when they enter the job market soon. In other words, a learning factory can improve the knowledge transfer process. Future research should investigate the relationship between learning factory facility, teaching techniques, and student performance. This research can also be expanded to include engineering and other technological disciplines in the study.

## ACKNOWLEDGEMENT

The authors would like to extend their gratitude to the Faculty of Industrial Management, University Malaysia Pahang for allowing the authors to conduct the study on learning factory project at the faculty.

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## CONFLICT OF INTEREST

The author(s), as noted, certify that they have NO affiliations with or involvement in any organisation or agency with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, jobs, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, expertise or beliefs) in the subject matter or materials addressed in this manuscript.

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