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Assessing UPM Initiative in Future Proofing Graduates through Innovative Physical Learning Environment

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Abstract: The aim of this paper is to study the effects of the fourth industrial revolution (I.R.4.0) on the learning methods and the physical learning environment. This paper reviews multiple theories of designing innovative future learning spaces to create a clear definition of the characteristics of a physical future learning environment. After creating a list of the required characteristics of a future learning environment, a visual observation is done to compare this list to the characteristics of the current innovative future learning spaces (Putra Future Classroom) in Universiti Putra Malaysia (UPM). This paper is written based on an ongoing study that aims to present an understanding on the strengths and the issues in the current design of the Putra Future Classroom. The findings of this paper could help create design guidelines for Universiti Putra Malaysia and other Malaysian universities to design a better innovative learning spaces that is designed to respond to the future changes in students' needs and learning methods. This study can contribute in improving the quality of higher education in Malaysia and the learning experience of the students and creating better prepared future proof graduates.

Keywords: Education 4.0, future learning, future classroom, personalization, learning experience

1. Introduction

In the past years, we have witnessed a revolutionary use of the internet and digitalization on our industry, business, education, and everyday life. This occurrence is referred to as Industrial Revolution 4.0, or I.R.4.0. which is defined as the evolution of cyber-system production and digital transformation (Shahroom & Hussin, 2018).

Like any aspect, education has been significantly affected by I.R.4.0 and the Internet of Things (IOT). The use of internet and digitalization, the technological evolution, the increasing demand for non-traditional learning and the increasing opportunities for professionally-oriented jobs which according to Keser & Semerci (2019) required students to have higher social skills and problem solving abilities has led to creating new teaching and learning methods which further led to the need to improve the physical learning spaces to serve these methods (Wagner & Wallner, 2016). Furthermore, this transition has also changed the way students receive the information and to seek freedom and control over the learning process which cannot be achieved through traditional learning models and spaces. The increasing diversity of students' nature and background due to the decrease of manual job opportunities which led to a higher number of people with different age, culture and backgrounds to seek higher education (Altbach, P. G., Reisberg, L. and Rumbley, 2018). This diversity has already created a gap between the students' needs and what the traditional learning models can offer, and this is where the nontraditional learning becomes essential.

2. Learning models in Education 4.0

Most communities in the era of I.R.4.0 are now moving toward interculturality and flexibility. This is what causes fresh graduates to face struggles when trying to find their place (Glasby, 2015). To help with that, learning models in Education 4.0 should offer flexibility and freedom which can help support the needs of the students. According to Redecker et al. (2016), a successful and supportive learning system should focus on personalization, collaboration and informalization. This can also help students to face their issues, develop better social skills and further engage in society.

Several learning methods has been created in response to that. These methods can be used alone or they can be merged together based on the content and the needs of the students. Collaborative and Group Learning has been widely used as they can help the students to share knowledge and develop social skills (Boruvkova & Emanovsky, 2016). Crossover Learning and Experience or Project-Based Learning have the ability to enrich the learning process with self-teaching through tasks, projects and experience to gain knowledge (Andresen, Boud, & Cohen, 2016). Computer Assisted Learning offers a variety of display which improves the content delivery process through computer programs and multimedia (Holt et al., 2016). Online Learning or distant learning offers learning from anywhere in the world which gives opportunities for many people with physical distance issue (Stern, 2014). The popularity of this type of learning has increased significantly all over the world in 2020 due to the lockdown, it allowed students to attend classes while practicing social distancing. And lastly, Immersive Learning which gives the students the ability immerse in the learning content and experience any environment through simulated or virtual environment (Shang Ly, Saadé & Morin, 2017).

3. Physical learning environment in relation to Education 4.0 learning models

Several theories have discussed the characteristics of a learning environment that has the ability to support the existing learning models and are flexible enough to adapt to future developments in learning and teaching.

All the theories are related in proposing a flexible design solution on the same concern. However, each of the theories analyses the issue from a different aspect. Theory 1 by Duvivier (2019) concentrates on the relation between formal learning and casual daily activities due to the increased usage of the internet and online learning and how the design of the learning environment should respond accordingly. Theory 2 by McDaniel (2012) described the increasing variety of students' backgrounds based on the changing market demands and the need for a flexible learning strategies and environment to cater these needs. The first two theories focused on the design of the learning environment in general and how to design informal spaces to serve the learning needs. However, Theory 3 by Kim, (2019) focuses specifically on the physical design of the classroom or the lecture room to provide students comfort, maintain their health and enhance their thinking. And finally, Theory 4 by Niemi, (2018) discusses the effects of new technologies on the learning environment and the need to create a flexible learning space that can adapt to the rapidly changing technologies.

3.1 Theory 1: Impact of technology on facilities by Robbert J. Duvivier (2019)

According to Duvivier (2019), todays learning tend to happen in more informal spaces than the actual classroom as long as these spaces provide comfort and an internet access, this means that every space in campus (corridors, lounges, cafes and etc.) can be designed to serve as a learning space. Students today find comfort and encouragement in places that offer a combination of food or drink services and a good wireless network with the working environment, that is why modern café are the first place to consider going to for both students and professionals (Brown, 2018). The increasing reliance of the students on the internet and

technologies in their daily life has led to a higher interaction between the physical and virtual world, this has also led to more interaction between the learning environment and the learning activities (Brown, 2018).

Considering these changes creates a need to redesign the physical learning environment in universities and higher education institutions to offer students the ability to merge the learning process and individual or group work with their daily living activities such as drinking and relaxing. This can be achieved through designing casual multi-purpose spaces that offer internet connection with a variety of services, technologies, and furniture settings that can provide comfort and serve the needs of every student (Duvivier, 2019).

3.2 Theory 2: Informal learning spaces by Stephanie McDaniel, AIA, LEED AP BD + C, (2014)

With the increasing variety of students' age and backgrounds, a range of formal and informal learning options should be offered by the universities to support everyone's needs. This is where these universities need to create a variety of flexible formal and informal learning spaces that can support these learning options. Because no matter how popular virtual and online learning becomes, a physical interaction in the learning process is still very important to the modern student (McDaniel, 2014). However, the new technologies has changed the style of learning from passive lecturer-led to active informal collaborative and self-led learning (Shah, 2013). Learning spaces design should consider these changes in the learning styles to offer a flexible, adaptive and personalized learning experience (Brown, 2018).

A flexible learning space should offer multiple types of furniture with different purposes, tables and chairs of different types and sizes, and a pantry area for the basic food or beverage services and other settings that can improve the students comfort (McDaniel, 2014). According to (Shah, 2013) most students are encouraged to spend time in spaces that offer them a sense of control. This can be achieved through using flexible space settings that the students can control and change according to their needs.

Direct contact between the formal (classroom) and informal spaces (courtyards or lounges) can also help students to relax and take breaks from the learning process. Both formal and informal spaces should provide a variety of display technologies, electrical ports and internet connection to encourage group work. A flexible learning space should also provide movable chairs and round or modular tables, working surfaces (white boards, chalk boards, screens and etc), storage areas and space dividers that can be used to divide the space into smaller individual or group work areas (McDaniel, 2014).

3.3 Theory 3: Flipped classroom by Andrew Kim, (2019)

A flipped classroom is an active and personalized space that contains a variety of flexible cluster furniture and round tables with multiple sizes. This type of setting gives the students the ability to work individually and in groups, it also allows the lecturer to move freely around the space for better interaction with the students (Kim, 2019). Flipped classrooms also contains relaxing lounge style corners that the students can use to take breaks and change the posture when needed. Natural indoor green elements and large windows with nature views are proven by studies to trigger the students' critical thinking (Kim, 2019). Screens and display surfaces are an important element in the design, along with movable working surfaces for easier knowledge sharing between the students (Jamilah, Yusof, Bakar, & Salim, 2018) (figure 1).

Figure 1. Flipped classroom by Andrew Kim, (2019).

3.4 Theory 4: Future learning environments Campus retrofitting by Niemi, (2018)

As the internet and technologies become a part of our everyday life, our ways of learning have also changed significantly and will continue to change with the constant development of these technologies. And with this change, the need to rethink the design of the learning spaces to adapt to the new needs became essential. Learning spaces today should be designed to be flexible and adaptive, containing multi-purpose spaces with multi-use digital and physical services. The space should be designed to support collaborative and group learning along with individual self-led learning (Niemi, 2018).

Larger spaces can use multi-levels that can used as seating areas as well as to divide the space into smaller spaces with different purposes. Various types of movable and flexible furniture, working surfaces, display surfaces, electric ports and a strong internet connection are all essential elements in the design (Niemi, 2018). Having break spaces is also very important for both students and lecturers, these spaces can be designed as lounges with pantry services for rest and refreshing (Niemi, 2018).

3.5 Comparison of theories

The method of creating the checklist was selected to create a clear set of characteristics that are agreed upon by different researchers with different specialties and points of view. Visual observation was done to achieve the main aim of this research, which is to evaluate the physical elements of a future learning space in Putra Future Classroom, find the strengths and the weaknesses and give recommendations for further design enhancement accordingly.

The original research, however, uses a questionnaire survey for the students using Putra Future Classroom to create a deeper insight on the satisfaction and the needs of Malaysian students in public universities in Malaysia. Interviews are also conducted with PFC lecturers, Design team and management in order to create a better understanding of the different needs and issues in designing spaces like PFC. The findings from the different methodologies are used to achieve the main objective of the original research: to give recommendations on designing the future learning facilities that can improve higher education quality in UPM which can furthermore provide guidelines for local universities to improve learning conditions and preparing graduates with better set of skills and knowledge.

By comparing the characteristics mentioned in theory 1 (Impact of technology on facilities by Robbert J. Duvivier (2019)), theory 2 (Informal learning spaces by Stephanie McDaniel, AIA, LEED AP BD + C, (2014)), theory 3 (Flipped classroom by Andrew Kim, (2019)) and theory 4 (Future learning environments Campus retrofitting by Niemi, (2018)) and taking only the elements that were shared by two or more theories (table 1).

Table 1. *Comparison of theories*

	Theory 1	Theory 2	Theory 3	Theory 4
Strong internet access 24/7	x	x	x	x
Combining living activities with learning	x	x	x	
Designing the spaces to be multi-use				x
Chalkboards, white boards and other working surfaces		x	x	
Merging screens, interactive surfaces and other learning technologies into the space	x		x	x
Access to electric ports		x	x	x
Direct connection between formal and informal gathering and learning spaces		x	x	x
variety of flexible and comfortable furniture		x	x	x
Access to pantry area		x	x	x
Movable dividing walls and shelves		x	x	x
small private spaces for individual work		x	x	x
Spaces for group work	x	x	x	x
Various sizes of movable round tables and chairs		x		
Multi-level spaces				x
Soft floor carpet and acoustic ceiling to create a good acoustic environment.				x

By taking only the elements that were shared by two or more theories (table 1), the final list of characteristics is defined as:

Strong internet access 24/7
Combining living activities with learning
Designing the spaces to be multi-use
Merging screens, interactive surfaces and other learning technologies into the space
Chalkboards, white boards and other working surfaces
Merging screens, interactive surfaces and other learning technologies into the space
Access to electric ports
Direct connection between formal and informal gathering and learning spaces
variety of flexible and comfortable furniture
Access to pantry area
Movable dividing walls and shelves
small private spaces for individual work
Spaces for group work
Various sizes of movable round tables and chairs

4. The characteristics of a future learning environment in Putra Future Classroom (PFC)

After creating a detailed checklist of the characteristics of innovative learning environment, a visual observation was conducted in PFC during class time to compare the checklist to the characteristics and physical elements provided in PFC.

The observation showed that the internet connection in PFC is considerably poor (650-1500 kbps/s) and covers less than 60% of faculty spaces. However, the connection process is easy and fast with no login required. A close pantry area is provided near the classroom with limited access to faculty staff. Food is neither provided nor allowed in the classroom. However, drinks are allowed and a vending machine for drinks and beverages is provided near the classroom (figure 2)

Figure 2. Vending machine outside of PFC.

The classroom provides good resting furniture. A comfortable sofa corner with thick cushion is provided that offers back support, neck support, arm support and pillows (figure 3). The chairs used in the classroom are also comfortable with cushions, back support, arm support but with no neck support. The furniture is highly flexible and easily movable. Modular tables are used with the ability to connect them to create a larger table or separate them for individual use (figure 4). However, space dividers and storage spaces are unavailable and therefore discussion corners and individual quite corners are also unavailable.

Figure 3. Resting corner in PFC.

Figure 4. Modular tables in PFC.

Heating and cooling systems are controlled by IOT. Which gives limited control for the students over the power and the temperature. The classroom is only available for students during class time, and napping or sleeping in the classroom is not allowed.

The classroom offers a variety of technologies. Large screens, interactive surfaces and projectors are provided with unlimited access for both the lecturer and the students and a sufficient number of electrical ports (1 port per 2 students) is also provided in every corner in the classroom (figure 5). The class also provides tempered glass boards for students' and lecturers' use. A direct connection between the classroom and outside courtyard with sitting areas is provided for resting and refreshment (figure 6).

Figure 5. Technologies in PFC.

Figure 6. PFC connection with outdoor resting areas.

5. CONCLUSION

By comparing the list with the findings of the observation, it is found that PFC provides a very good physical setting, the furniture used in the classroom provides flexibility which can change the configuration of the classroom based on the content of the subject or the needs of the students. The lounge sofa and bean bag corner helps students to rest and take breaks from the chair sitting posture. The chairs used in the classroom are movable and comfortable and the modular shape of the tables makes the classroom highly flexible and adaptive to any present or future learning activity.

The technologies provided in the classroom offer a great learning and teaching experience for the students and the lecturer. The interactive 60" touch screen offers an easier media for content delivery. The number of screens used help students from every corner in the classroom to have a clear view to the screen. The smart connection system and the easy internet connection process help students to engage their personal phones or tablets in the learning process by sharing the screen with the lecturer and with other students and using the device camera to create an augmented reality. The classroom even provides a sufficient number of electrical ports which makes PFC BYOD (Bring Your Own Device) friendly, this allows students to bring their own laptops or other devices when needed.

The classroom also provides a direct connection with an informal outdoor courtyard space with sitting areas and a vending machine, this connection allows students to go outside and relax and refresh whenever they feel stressed.

However, a large category of characteristics is missing in the design of PFC. The classroom is not available for the students outside class time, and the prohibition of daily living activities (eating, taking rest naps) in the classroom prevent students from having a sense of control and ownership over the space which reduces their comfort and desire to spend more time in the classroom. The poor internet speed might cause a barrier when the learning process is in progress especially those which includes live streaming or video streaming.

In general, PFC in UPM offers a very good physical setting and technologies. However, improving these spaces can be achieved by focusing more on merging the daily living activities in the learning process and permission of usage outside the formal class time. This can be done easier when the space is designed as a "learning space" rather that a "classroom" that is open for the students and provides services that can increase the comfort of the students and their sense of control over the space.

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