EFFECTIVENESS OF PUTRA FUTURE CLASSROOM AS A PHYSICAL LEARNING ENVIRONMENT

By

ALMAWALDI MUNA

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

August 2021

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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August 2021

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Traditional physical environment in the university learning space is becoming inadequate due to the changing of learning styles from direct to student centered learning. These traditional models of teaching and learning are being outplaced by the digital revolution of the twenty-first century. The new learning models are no longer supported by the traditional classroom and the university campus design. In order to improve the students' learning experience, it is imperative to provide physical learning environment that cater the new learning styles and needs.

The thesis intends to improve the students' learning experience by providing a physical learning environment that cater to new learning styles and needs. Thus, the design of future learning spaces in UPM is proposed. The research also aims to provide recommendations and guidelines on creating an innovative physical learning environment of the future through understanding the learning needs of the students in UPM learning facilities and evaluating the elements of a future learning space that can be seen in UPM future classrooms. To achieve that aim, mixed methods of qualitative and quantitative research are used to collect and analyse the data. A visual observation and a student survey are conducted in the future learning spaces. An interview is also conducted to get feedbacks from the lecturers, designers and management staff of the future learning space. A total number of 120 student were surveyed and 17 staffs were interviewed in this research.

The data from the survey was analysed using the SPSS (Statistical Product and Service Solutions) software. Descriptive analysis is used to analyse the data from the visual observation, and thematic analysis for interview data analysis. The study finds that while high quality technologies and physical design is used

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in these spaces, several issues can still be addressed to improve the overall learning environment in terms of physical space layout and function, digital infrastructure and space management. The findings from this study which include the strengths, weaknesses, and issues in the design of future learning spaces in UPM are used in giving recommendations and guidelines to improve these spaces for UPM in their efforts to produce excellent graduate. For further research, the research will encompass bigger samples and other Malaysian universities. The result of the research will contribute towards the improvement of the quality of higher education in Malaysia.

In conclusion, UPM is putting efforts on improving the learning environment on the campus. However, by addressing the issues in the findings of this research, the learning environment can be improved even further.

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Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KEBERKESANAN *PUTRA FUTURE CLASSROOM* SEBAGAI PERSEKITARAN PEMBELAJARAN FIZIKAL

Oleh

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Persekitaran fizikal yang tradisional di dalam ruang pembelajaran universiti dilihat semakin tidak relevan disebabkan oleh perubahan daripada cara pembelajaran satu hala kepada pembelajaran berpusatkan pelajar. Model pengajaran dan pembelajaran tradisional ini digantikan oleh revolusi digital abad ke-21. Model pembelajaran baru tidak lagi disokong oleh reka bentuk tradisional bilik darjah dan reka bentuk kampus. Bagi menambah baik suasana pembelajaran pelajar, penyediaan suasana pembelajaran fizikal adalah sangat penting bagi menampung stail pembelajaran dan keperluan baharu ini.

Tesis ini bertujuan untuk menambah-baik proses pembelajaran pelajar dengan menyediakan suasana pembelajaran fizikal yang kondusif untuk cara pembelajaran dan keperluan masa kini. Oleh itu, reka bentuk untuk ruang pembelajaran pada masa depan di UPM telah diusulkan. Kajian ini juga menyasarkan untuk memberi cadangan dan garis panduan bagi mencipta suasana pembelajaran fizikal yang inovatif dengan mengkaji keperluan pelajar sesuai dengan arus masa dan menilai elemen ruang pembelajaran masa depan yang terdapat di UPM. Bagi mencapai matlamat kajian, metodologi kualitatif dan kuantitatif digunakan untuk mengumpul dan menganalisa data. Pemerhatian visual serta kaji selidik melibatkan pelajar telah dilakukan di dalam ruang pembelajaran tersebut. Selain itu, temu bual turut dilaksanakan bagi mendapatkan maklum balas daripada pensyarah, kakitangan pentadbiran, dan pereka bentuk ruang pembelajaran tersebut. Seramai 120 pelajar-terlibat dalam kaji selidik manakala 17 orang kakitangan telah ditemu bual dalam kajian ini.

Hasil dapatan daripada kaji selidik dianalisa menggunakan perisian komputer *Statistical Product and service Solutions (*SPSS). Analisa deskriptif digunakan untuk menganalisa data diperoleh melalui pemerhatian visual manakala analisis

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tematik digunakan untuk menganalisa data diperoleh melalui temu bual. Kajian mendapati bahawa, walaupun teknologi dan reka bentuk berkualiti tinggi digunakan dalam ruang pembelajaran ini, beberapa perkara tetap perlu diambil kira bagi memaksimumkan suasana pembelajaran yang kondusif seperti susunatur dan fungsi ruang fizikal, infrastruktur digital dan pengurusan ruang. Dapatan kajian termasuklah kelebihan, kekurangan, dan isu lain dalam reka bentuk ruang-ruang pembelajaran di UPM digunakan sebagai garis panduan untuk penambahbaikan suasana pembelajaran di masa hadapan bagi membantu UPM melahirkan graduan cemerlang. Bagi kajian selanjutnya, kajian akan melibatkan sampel yang lebih besar dan penyertaan daripada lain-lain universiti di Malaysia. Hasil kajian ini akan memberi impak terhadap penambah baikan kualiti di institusi pengajian tinggi di Malaysia.

Kesimpulannya, UPM berusaha untuk menambah baik suasana pembelajaran di dalam kampus. Walau bagaimanapun dengan mengambil kira dapatan daripada kajian ini, ruang pembelajaran yang kondusif dapat dinaik taraf dengan lebih maksima.

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This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

UPM	Universiti Putra Malaysia
PFC	Putra Future Classroom
IOT	Internet Of Things
I.R.4.0	Industrial Revolution 4.0
APU	Asia Pacific University
SDG #4	Sustainable Development Goal 4
SPSS	Statistical Product and Service Solutions
I.R.1.0	Industrial Revolution 1.0
I.R.2.0	Industrial Revolution 2.0
I.R.3.0	Industrial Revolution 3.0
MOOC	Massive Open Online Course
GOP	Gross Domestic Product
MRP	Manufacture Resource Planning
VR	Virtual Reality
MR	Mixed Reality
AR	Augmented reality
GSMA	Global System for Mobile Communications
IPv6	Internet Protocol version 6
MIT	Massachusetts Institute of Technology
RFID	radio frequency identification
MOE	Malaysian Ministry of Education
MEB-HE	Malaysia Education Blueprint - Higher Education
ICT	Information and Communication Technology

TEL	Technology Enhanced Learning
BYOD	Bring Your Own Device
TESL	Bachelor of Education
HRD	Human Resource Development
MCO	Movement Control Order
CADe	Centre of Academic Development

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The rapid advancement in technology and fast-paced industry development are affecting the quality of the workforce all over the world. The readiness of the workforce to cater to this phenomenon is directly related to the quality of the graduates being churned out from the higher learning education institutions. Certain level of skills and knowledge are expected of these successful fresh graduates.

Kuh (2006) explained that the definition of success of students is very wide, but mostly it is the achievements of students during their academic years and after. The success of a student is far wider that a high GPA, it is how students behave and how they interact with their collage experience, classmates, and institutional conditions. These factors play a huge role in student's success and health.

In Malaysia, which has 20 public universities, 53 private universities, and six foreign university branch campuses, the five leading universities are Universiti Putra Malaysia, Universiti Malaya, Universiti Kebangsaan Malaysia, Universiti Sains Malaysia and Universiti Teknologi Malaysia. These universities have been given autonomy in administration, human resources, financial and academic management and student intake (StudyMalaysia, 2020).

As top five of the leading public Malaysian universities, these universities care about their educational quality, students experience is a big part of that quality, for those reasons many universities work constantly to keep up with the modern learning methods and developments. However, many other universities are being left behind when it comes to going with the stream of evolving and updating their learning experience.

According to upm.edu.my (2019), Universiti Putra Malaysia (UPM) is one of the five top leading public universities in Malaysia, it is considered on the top 100 universities in the world in Agriculture, top 200 in Language, Architecture, Chemistry and Business Management (Figure 1.1).

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Figure 1.1 : UPM University ranking
(Source: upm.edu.my, 2019)

As a leading university, UPM is putting effort into catching up with the changing educational world by creating future learning spaces that merge technologies with learning to improve the learning experience of the students, one of these space (Putra future classroom (PFC)) has already been opened and used since 2017. However, these spaces lack many of the important elements that are used to define a future learning space.

1.2 Research Background

The author is an international student in UPM University and a former student in Limkokwing University, she also studied in Damascus University for three years. The author has a degree in Architecture and Built Environment from Limkokwing University of Creative Technology.

As a student in a local Syrian University and two different universities in Malaysia (public and private) the author has noticed the efforts of UPM to engage their learning spaces with the new learning methods and trends. As a personal point of view, the author also notices the struggles of both international and local students in the current UPM campus learning facilities. Also the new culture and changes the international students experience is very challenging to them which affects them socially, culturally, physically and psychologically by trying to adapt into the culture of the country where they study (Wu et al. 2015).

The author believes that UPM learning environment still requires a lot of work as it lacks many of the elements that are essential to be prepared for the future learning in terms of space configuration and function, quality of digital infrastructure and space management methods (Figure 1.2).

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Figure 1.2 : Traditional learning in UPM University
(Source: upm.edu.my, 2019)

Even though most learning spaces in UPM are still traditional which means that innovative teaching and learning models are mostly unsupported in the form of face-to-face education, when it comes to online learning, UPM does offer some internet related learning methods, as many classes use online platforms to download notes, assessment, and communication with the lecturer. However, it is facing difficulties in merging the internet related or the physical experience in the class itself, which apart from the physical design, limits the learning types that can be practiced in the classrooms. According to Ivanović et al. (2018), integrating technologies and internet of things in the classroom environment has a big effect on improving the learning experience and enhancing the motivation and satisfaction of the students. UPM campus also offered the students the use of an all- time internet connected computer lab and an online library (Figure 1.3).

Figure 1.3 : Lecture theatre teaching in UPM University
(Source: upm.edu.my, 2019)

There has been some work toward creating future classrooms in some facilities in UPM. One classroom (PFC) has already been created in the Faculty of Educational Studies, while other classrooms in the same faculty and other faculties are still under development. However, these classrooms are lacking many of the requirements that are important to create a future learning space such as flexibility in configuration to achieve multi-usability, connection between formal and informal spaces, high quality digital infrastructure and flexibility in space management.

The evaluation of the space in this research focuses on the physical design of the learning environment rather that the curriculum as it analyses the space from an architectural vision. However, the space users are students from a non-design faculty.

In order to evaluate these classrooms, in this research the author studies the previous theories on the future physical learning environment before making a clear list of the design requirements of a future learning space that allows the space to support any type of future learning.

Table 1.1 investigates some of the biggest and main previous studies on the topic. These studies have been analysed to contribute in the writing of this research.

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Table 1.1 : The main previous studies on future learning spaces

Topic	Author	Title	Area of research
Future learning space design	(Deshmukh 2019)	Students' Preference on Traditional and Modern Education	The transformation of the old and active education model with the integration of the internet.
	(Clarke et al. 2020)	The Influence of Traditional and Modern Learning Spaces on Pedagogical Affect, Classroom Community, and Learning Outcomes for Marketing Students	The difference of the effects of traditional and active learning spaces on marketing students.
	(Park, 2014)	Transformation of classroom spaces: traditional versus active learning classroom in colleges	the history and scenarios of education and learning spaces through history and the perception of college students on active learning spaces.
	Attis and Koproske (2013)	Thirty Trends Shaping the Future of Academic Libraries.	The effects of the latest revolutions in education on the design of the libraries in higher education institutions.
	Brown (2018)	Educause Learning Spaces	The effects of innovative learning models on the design of learning spaces in higher education.
	Duvivier (2019)	Future-Proof' the Use of Space in Universities by Integrating New Digital Technologies	The author discusses the characteristics of learning spaces in higher education institutions to support the changing educational models and styles.
	Horn (2018)	Will Half of All Colleges Really Close in The Next Decade?	The effects of using traditional learning environment on higher education quality and the future of higher education institutions.
	Ibrahim et al. (2013)	Learning Outside Classrooms on Campus Ground: A Case Study in Malaysia	The effect and role of informal learning spaces on the learning process in higher education institutions.
	Jamilah et al. (2018)	Designing Spaces for Active Learning In Teaching Software Engineering Courses."	The benefits of future learning spaces in higher education and the characteristics of a future classroom.
	Kim (2018)	Class Can I Have Your Attention	The effects of a future classroom design on the comfort and participation of higher education students
	Matthew et al. (2012)	Designing informal learning spaces using student perspectives. Journal of Learning Spaces	The author discusses the requirements of an informal learning space based on the needs and perception of higher education students.
	McDaniel (2014)	Every Space Is a Learning Space	The author explains the role of different formal and informal spaces in the learning process of higher education and the design requirements of these spaces.
	Niemi (2018)	Future Learning Environments Campus Retrofitting Agenda Introduction CARE - CORE Co-Creation Co-Financing Co-Evaluation Conclusions	The author investigates the effectiveness of future learning environment design through the analysis of an existing case study.

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Table 1.1 : Continued

	Saunders et al. (2017)	SMART Teaching in New and Old Classrooms	The author discusses the importance of creativity in teaching by utilizing all the available resources in any learning space.
	Woolcock (2017)	Death of the university lecture theatre	The article investigates the renovations in learning spaces requirements and the effects of using traditional learning spaces for today's education
Pedagogy	(Belias et al. 2013)	Traditional Teaching Methods Vs. Teaching Through the Application of Information and Communication Technologies in The Accounting Field	The issues and outcomes of traditional learning vs. innovative learning using technologies and their effect on future proofing graduates.
	(Gleason 2018)	Higher Education in the Era of the Fourth Industrial Revolution	The author discusses the transformation of pedagogy and the learning environment and scenarios through the four industrial revolutions.
	(Pervez et al. 2018)	Role of Internet of Things (IoT) in Higher Education	The effects of IOT pedagogy in higher education and the learning styles in the 21st century.
	Altbach et al. (2018)	Trends in Global Education: Tracking an Academic Revolution	The revolution of higher education styles and their effects on the students' outcomes.
	Ayub et al. (2014)	Use of internet for academic purposes among students in Malaysian institutions of higher education	The effects of the integration of internet and other technologies on the satisfaction and the learning experience of Malaysian higher education students.
	(Becher and Becher, 2018)	Informal Learning	The article discusses the different models of informal learning and their role on higher education in the 21st century.
	Gang (2019)	Future-Proofing Graduates (Co-Curriculum and Extra-Curriculum)	The effects of the curriculum design of the adaptability of the students and future proofing graduates of higher education
	Glasby (2015)	Future Trends in Teaching and Learning in Higher Education	The author investigates the effect of internet and technologies on the learning and teaching styles in higher education.
	Milligan et al. (2020)	Future-Proofing Students: What They Need to Know and How to Assess and Credential Them	The important elements in higher education pedagogy, teaching styles and assessment for improving the student's adaptability and flexibility.
	PAN EU JOE (2019)	Future-proofing students' life-long careers	The author discusses the effects of pedagogy and higher education style on the success and adaptability of the graduates to the market demands.
	Wagner et al (2016)	Academic Education 4.0	The article investigates the innovations in learning and teaching in the Fourth Industrial Revolution and the effect of the new innovations on the quality of academic education.

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According to Milligan et al. (2020), future learning styles aim to improve the students' learning experience and social skills, including communication, critical thinking and problem solving through enhancing collaboration between the students and the faculty and enhancing students' comfort and participation in the learning process through a personalizes and flexible curriculum as well as a supportive design of the physical learning environment. These skills are crucial in creating future-proof graduates who are adaptive to the challenges and changes of the career demands. Future learning styles were created to address these issues and develop these skills. These learning styles are a result of merging several innovations into the learning process such as the internet and learning technologies. This transformation in education is referred to as Education 4.0.

In the past years, the internet started to take a big place in the educational experience, as the internet's role grow bigger and bigger in every day's life, education, and industry. This revolutionary use of the internet and the digitalization in every field of the modern life is currently being referred to as Industrial Revolution 4.0 (I.R.4.0).

Shahroom and Hussin, (2018) explained that I.R.4.0 is the digital transformation of the industrial market, it can be defined as the evolution of cyber-system production, and even though it started in the manufacturing field, it has changed wider to affect our governmental, industrial and educational experience.

According to Tan (2018), I.R.4.0 is the fourth industrial revolution, starting with the first industrial revolution which was the mechanization, steam power and utilizing water. The second industrial revolution was more involved with the electricity and mass production. The third industrial revolution was more of the rise of the automation in manufacturing, which created the factories that we see today (Figure 1.4).

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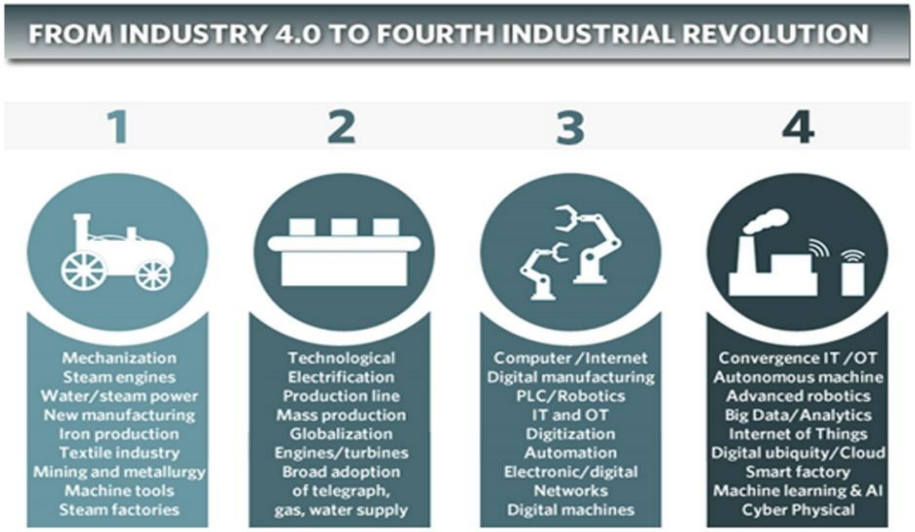

Figure 1.4 : The four industrial revolutions
(Source: Tan, 2018)

According to I-SCOOP (which is a leading marketing consultant which provides research, training and consultation regarding digital services) there are many phases of I.R.4.0 that have affected our lives widely in nearly every aspect.

The main phases of I.R.4.0 include Cloud computing, System integration, Simulation, Additive manufacturing, Autonomous robots, Big data, Augmented reality, Cybersecurity and most importantly the Internet of things (Figure 1.5). The internet of things was probably the biggest achievement of the industrial revolution and it is growing bigger every second, it has changed the way we think, socialise, teach and learn.

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Figure 1.5 : The main phases of I.R.4.0
(Source: Morgan, 2017)

1.2.1 IOT in Education

According to Morgan (2017), IOT can be defined as the ability to connect and disconnect any device to the internet at any time, whether it is a mobile phone, a car, or an oven, as long as it has a ON and OFF connecting switch, that means it is part of the IOT. Morgan also explained that by 2020 there will be over 100 billion devices that has a connection to the internet that also includes humans, which creates a huge network of devices or "things".

According to Pearson (2017), there are 5 main ways that the IOT affects our lives through Business and manufacturing, Health care, Retail, Security, Transportation and Education which was widely affected with the changes of market demands and modern students' needs.

We have been noticing huge changes in the educational industry, these changes are mostly related to the IOT, such as tech learning innovations, students and lectures connectivity, and indirect learning through the internet are providing great opportunity in the development of education.

According to Mehta (2018), IOT has changing education through the use of internet connected devices for remote and automated tasks, creating a more efficient teaching process, special education, safety, and creating new learning methods that supports the needs of the students in the IOT era.

1.2.2 New learning methods

There are a few new teaching / learning methods that came along with the IOT. Woolcock (2017) stated that students in both schools and universities are rejecting the old direct teaching methods that they are experience learning from the internet and social media every day. These students started to find the normal classes and lecture theatre boring and no longer a successful way in delivering the information. This is where the need comes to rethink the design of the learning spaces (Figure 1.6).

Figure 1.6 : Café-style teaching areas are replacing halls accommodating hundreds of students
(Source: Woolcock**,** 2017)

There are several teaching and learning methods that are being proposed or currently being used by schools and universities around the world, some of these methods are Online Learning, Group Learning, Crossover Learning, Computational Learning, Learning by doing science, Immersive Learning and

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Informal and Indirect learning. Rüütmann et al. (2011) explained that informal learning is the most important type of learning in our current time as most of learning today happens outside the classroom.

1.2.3 Learning Spaces in IOT

The changes in the learning styles have made a need for new approach of the learning space. Traditional learning spaces are no longer supportive of the learning activities or the new learning needs of the students.

Several researches have been made on the characteristics of a modern or futuristic learning space, nearly all agree that a supportive learning space much be flexible in the design and layout to adapt to multiple learning activities. Brown (2018) stated that in order to survive, higher education institutions need to upgrade their learning environment and learning approaches in order to support the constant changes in education and the learning needs.

Successful higher education institutions in the 21st century carry the responsibility of future proofing their graduates to be adaptive to the changing market demands (Pearson, 2017). Therefore, students need to learn important skills such as problem solving, critical thinking, communication and collaboration. The modern learning methods were developed to enhance these skills. This is where a new design of the physical learning environment is needed to support the different learning activities, increase the students' comfort, improve their learning experience and improve the overall higher education quality.

1.3 Problem Statement

A study by Harvard Business School professor Clayton Christensen in 2018 shows that, in fifty years, if not sooner, half of the colleges and universities in most countries will no longer be operating unless tragic changes were made by then (Christensen et al., 2018). Horn (2018) explained the reason is that most of these universities still follows the teaching methods from the 19th century, where only direct learning was presented.

These traditional models of teaching and research are being outplaced by the digital revolution of the twenty-first century. The new learning models are no longer supported by the traditional classroom and the whole university campus design.

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In UPM campus, some changes and movements can be seen in some facilities that are related to these issues, in the Faculty of Educational Studies, Putra Future Classroom (PFC) has already been created and used since 2017. However, **there's a lack of sufficient research to support the design of PFC. Therefore, the physical design of PFC can be improved through space analysis (Niemi, 2018) based on a comparison with research and selected global theories on the design of future learning spaces, and the user feedback (Park, 2014). This to create a more reliable and effective design that can be fully utilized to improve the learning experience of the students and improve higher education quality (MOE, 2015).**

Furthermore, the general environment of teaching is still traditional, as the single table and chair style classes and lecture theatre are still the major teaching spaces look in UPM. Sani (2019) explained that this type of teaching environment has negative effects on the students. These effects can be seen in the level of interest and attendance of most students which is reflecting poorly on the performance of these students and it will continue to grow unless some changes are made on the physical design of the learning spaces.

Sani (2019) also stated that the lack of technologies merged in the overall educational process in UPM is concerning as it does not create future-proof graduates. The lack of merging technologies into the learning process leads to limited number of teaching and learning types that can be practiced in the space as most innovative and future learning methods require internet connection and the use of technologies. The future learning methods are designed to improve the social skills and adaptability of the students which is the most important feature of a future-proof graduate (Milligan et al., 2020). According to Gang (2019), in order to improve the students' social skills, critical thinking and adaption with different working environments, educational institutions need to use teaching and learning methods that enhances collaboration and challenges the students' learning abilities and communication skills. These methods require a learning space that can support the variety of learning activities required to achieve that goal. This means that the students graduating from UPM university are not prepared for the I.R.4.0 automation and Artificial intelligence. Research from global professional network LinkedIn shows that by 2020, 50 million jobs will be replaces by Artificial intelligence.

Some of the universities in Malaysia are working on addressing and solving these issues by constantly updating and evolving the learning strategies and environment. Some universities like Asia Pacific University (APU) are now considered as one of the leading universities in merging the I.R.4.0 technologies into their educational process which allowed their graduates to become future-proof graduates (Pan Eu Joe, 2019). The traces of this movement can be seen in UPM through their effort in creating future classrooms. However, these spaces are not being designed based on theories of future learning space elements and requirements, which might not be helpful in fulfilling the needs of the students

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and the future preparing and demanding educational system. These theories on the effect of new technologies, new learning methods and the changes in the students' needs are important to understand the design requirements of the future learning space and the philosophies behind these requirements. Therefore, these theories are discussed later in this research.

As a result, the research investigates the existing UPM physical future learning environment represented by PFC, and measures students' satisfaction & needs on the existing UPM future learning spaces in order to create future proof graduates and to reflect Sustainable Development Goal 4 (SDG #4) which is to ensure inclusive and equitable quality education and promoting a lifelong learning opportunity for all. This is set to ensure accessibility to quality education that can help the learners to participate in community and have a productive life. However, this research focuses on the physical design of PFC rather than the pedagogy and the curriculum due to the architecture background of the author. PFC is used for non-design-based students. Therefore, the design of PFC might be supportive for non-design-based students and programs, while a different approach might be needed in design-based future learning spaces.

1.4 Hypothesis

The current learning facilities in UPM are experiencing a shortage of development of their learning spaces and types, these spaces need to be improved in terms of physical design, technological services and management to better support the future learning and to improve the learning experience of the students and help create future-proof graduates.

1.5 Research Framework

This research focuses on assessing the future learning spaces in UPM, finding the issues and creating guidelines for designing an innovative or "future" learning space. The aim of this space is to improve the learning experience and the social skills of the students, enhance their communication among each other's and with the lecturers and improve their critical thinking and problem-solving skills.

Mixed methodology approach was used in this research. According to Creswell (2012), mixed methodology approach can be used when quantitative or qualitative approach by themselves are inadequate to best answer the research questions and aims. In this case, using mixed methods from qualitative and quantitative approach can provide the best understanding for the research problem. In this research, the author first investigates a concept to learn the important variables to study (Qualitative), then studies these variables on a sample of the affected individuals (Quantitative). Finally, the author follows up

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with a few participants to understand their detailed views about the topic or concept (Qualitative).

Three different methodologies were used to collect the data and fill the gaps to create the guidelines and the recommendations for creating a successful future learning space.

- Observation: a visual observation was conducted in "Putra Future Classroom or PFC" in the Faculty of Educational Studies in UPM. The variables or the checklist of the observation was created based on the literature review and the comparison of theories.
- Survey: a set of questionnaires was given to the students using PFC. The survey aims to understand student's opinion and satisfaction towards the future learning elements in PFC.
- Interview: interviews were conducted with lecturers, management staff, and designers of PFC which helps create a deeper understanding of the aims and the issues towards creating future learning spaces in local Malaysian universities.

The proposed guidelines created based on the data collected in this research has several limitations:

- The survey is conducted upon students from two faculties and three different programs only. The needs of these students might not necessarily be the same as students from other faculties.
- The observation was conducted on only one classroom (PFC) due to access limitations to other spaces which are still under development.

In the research, the literature review studies the relationship between I.R.4.0 and IOT with education, modern students and the relevant theories on the design of learning spaces. The methodologies used in this research are a mix of qualitative and quantitative, the observation (qualitative) variables were created based on the comparison of theories on the design of future learning spaces. The same variables were used in creating the survey questions (quantitative) to create a supporting data. And the interview questions (qualitative) were created to create a deeper understanding of lecturers and experts' opinion the space design issues. The data collected in the methodologies is analysed using the Statistical Analysis Software Package (SPSS) version V27.

1.6 Research Aim and Objectives

This study covers the physical changes that are being or should be made to achieve that goal through a case study on UPM university future learning

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classrooms in Serdang to analyse and study the preparation of these spaces to the new learning styles.

1.6.1 Research Aim

The main aim of this research is to give recommendations on designing the future physical learning environment that can improve higher education quality and create future-proof graduates in UPM campus learning facilities. This aim can be achieved by identifying the strengths and the limitations of these spaces toward future learning. The findings can be used to establish guidelines on improving the design of future learning spaces in UPM.

1.6.2 Research Objectives

The first objective is to study the current physical learning environment and the learning needs of the modern students in UPM learning facilities. By investigating the current design features, the needs and the demands of these students, and finding their satisfaction on the available resources and how they feel toward different future learning space elements. This can help in creating guidelines that supports the needs of the students in public Malaysian universities.

The second objective is to evaluate the elements of a future learning space that can be seen in UPM future classrooms. By investigating the availability of the essential elements of a future learning space in the future classrooms in UPM, and to evaluate the utilization of the available resources to create a better learning experience for the students.

1.7 Research Questions

The main research question is: How can UPM future learning spaces be developed to support future learning and improve the students' learning experience to create future-proof graduates?

The research has two sub-questions: What are the learning needs of the modern students in UPM learning spaces that can be addressed through the design of the future learning environment to improve their learning experience? and What are the characteristics of a future learning environment that can be found in UPM future learning spaces?

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1.8 Research Methodology

The first part of the data is to be collected through research into the future of learning and new learning space design philosophies.

the second part of the data is collection through Mixed methods approach. According to Creswell (2012), mixed methods approach involves the collection and “mixing” or integration of both quantitative and qualitative data in the study.

The objectives of the research require a mixture of both qualitative and quantitative data collection as objectives 1 and 2 investigate into different kind of data. Therefore, a case study visual observation, a student survey and an interview are used to achieve objectives 1 and 2. Objective 3 can then be achieved from the findings (Figure 1.7).

The three methods used in the research are:

i) Analysing the current future learning classrooms in UPM through visual observation. The findings of this analysis can answer to Research Objective 2: To evaluate the elements of a future learning space that can be seen in UPM future classrooms.

ii) Survey for students in the classroom on their satisfaction toward the current classrooms and the different elements of a future learning space. The analysis of the survey can present the answer to Research Objective 1: To study the current physical learning environment and the learning needs of the modern students in UPM learning facilities. By investigating the current design features.

iii) Interviews with classroom lecturers, designers and management to create a deeper understanding of the issues and the philosophies of the space design. The findings from the interview analysis, together with the findings from the previous two methods can help achieve the Research Aim which is to give recommendations on designing the future physical learning environment that can improve higher education quality and create future-proof graduates in UPM campus learning facilities.

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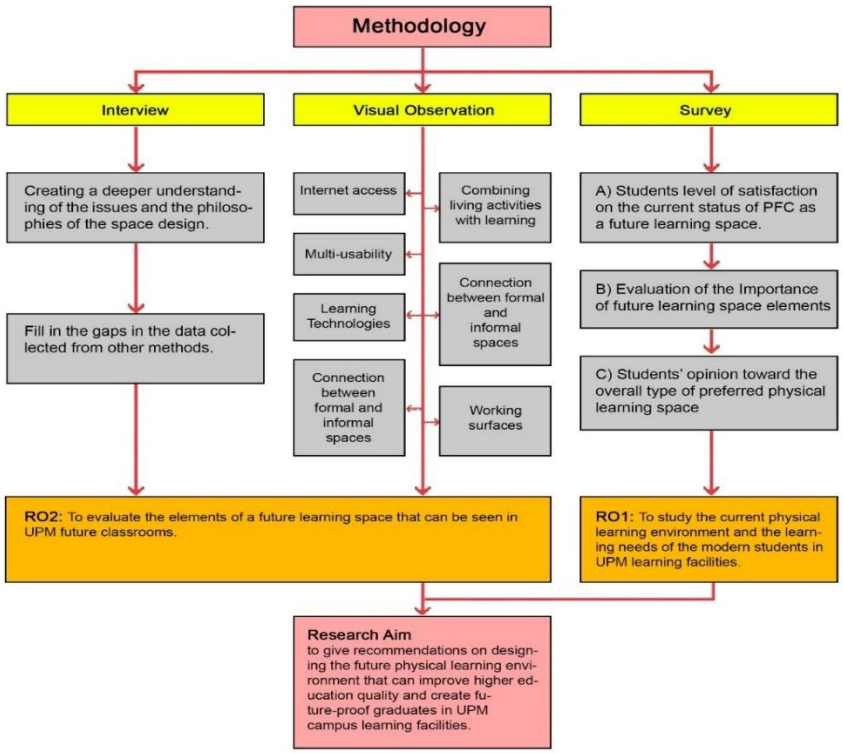

Figure 1.7 : Research methods

1.9 Data Analysis

Several methods of data analysis were used in this research based on the type of the data and the collection method:

i) Data collected through the visual observation is analysed through descriptive analysis by comparing the design elements of the space with the list of characteristics from the theories.

ii) Survey data is analysed through Statistical Product and Service Solutions (SPSS) software version V27.

iii) Thematic analysis was carried out for the interview data.

The findings from the three different methods are used to form a list of issues in the design of the future learning spaces in UPM.

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1.10 Significance of the Study

The results and findings of this study can be used as a reference for developing existing university learning spaces and designing new future learning spaces in local universities in Malaysia. This can improve the quality of the education and the learning experience of the students, and create better prepared future-proof graduates as the success of an institution can be measured from the success of its graduates.

The study demonstrates the benefits of the new educational styles in students learning experience and their effects on the students' success. It also studies new models and concepts in future campus design which can be used and further improved by other professionals in the same field.

1.11 Scope and Limitation of the Study

The main focus of the study is to find the main criteria that creates a future prepared learning environment and compare these points with the current learning spaces in UPM.

The study also points out the issues and limitations that the future learning spaces have and give recommendations on how these issues can be solved to create a more affective learning environment.

However, this study covers only one future classroom in UPM Serdang campus, and it focuses mainly on classroom design.

1.12 Summary

This chapter covers an introduction of the significance and the issues of this research. The purpose of this study is to find the benefits of recreating the future learning spaces in UPM and their effect on the learning experience and skills of the students. This Chapter provides a detailed study of the issue and a simple study of the effects of the I.R.4.0 on changing the educational styles that will be covered further in the other Chapters.

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