EMPLOYABILITY SKILLS AMONG MALAYSIAN POLYTECHNICS' ARCHITECTURAL GRADUATES INVOLVING BUILDING INFORMATION MODELLING (BIM) INTENSIVE TRAINING IN ARCHITECTURE FIRM

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LIST OF SYMBOLS

α	Cronbach's Alpha
β	Beta
R^2	R square
SE	Standard Error
SD	Standard Deviation
r	coefficient
t	Significant
N	Population
n	Sample

LIST OF ABBREVIATIONS

BIM	Building Information Modelling
PUO	Politeknik Ungku Omar
POLISAS	Politeknik Sultan Haji Ahmad Shah
POLIMAS	Politeknik Sultan Haji Abdul Halim Mu'adzam Shah
PPD	Politeknik Port Dickson
PMM	Politeknik Merlimau Melaka
PSIS	Politeknik Sultan Idris Shah
CITP	Construction Industry Transformation Programme
AEC	Architecture, Engineering, and Construction
CIDB	Construction Industry Development Board
KPI	Key Performance Indicators
TVET	Technical and Vocational Education and Training
MoHE	Ministry of Higher Education
PWD	Public Works Department
LAM	Board of Architect
SPSS	Statistical Package for Social Science
IV	Independent Variables
DV	Dependent Variables
FKAB	Faculty of Built Environment
HCT	Human Capital Theory
MEP	Mechanical, Engineering and Plumbing

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KEMAHIRAN KEBOLEHPASARAN DALAM KALANGAN SISWAZAH SENI BINA MELIBATKAN LATIHAN INTENSIF BUILDING INFORMATION MODELLING (BIM) DI MALAYSIA

ABSTRAK

Pemodelan maklumat bangunan (BIM) merupakan pendekatan baharu dalam memantapkan industri pembinaan menuju revolusi industri 4.0 (IR 4.0). Kelebihan dan kecekapan teknologi BIM kepada industri akan menyumbang kepada pembangunan pembinaan seterusnya menyediakan lebih banyak peluang pekerjaan kepada graduan politeknik Malaysia. Kajian berkenaan BIM sebelum ini berfokus pada pelaksanaan dan halangan untuk menerapkan BIM dalam industri pendidikan dan pembinaan. Beberapa kajian menjelaskan sejauh mana kemahiran dan pengetahuan BIM mempengaruhi pengambilan pekerja baharu dalam industri ini. Kajian ini bertujuan untuk mengenal pasti tahap kemahiran berhubung dengan BIM dalam kalangan siswazah seni bina. Kajian ini juga mengenal pasti jenis kemahiran BIM yang boleh meramalkan kebolehpasaran siswazah seni bina dan kemahiran yang dicari-cari oleh majikan. Pendekatan kuantitatif digunakan sebagai reka bentuk penyelidikan yang utama. Pendekatan kualitatif melalui temu bual secara berseorangan turut digunakan untuk menyokong penemuan kaji selidik. Statistik deskriptif dan berdasarkan inferens yang mengguna pakai hubung kait (korelasi) dan regresi digunakan untuk menganalisis data kuantitatif, dan analisis tematik digunakan untuk menganalisis data kualitatif. Hasil kajian menunjukkan tahap kemahiran BIM dalam kalangan siswazah seni bina adalah sederhana. Semua pemboleh ubah didapati mempunyai hubungan positif yang ketara antara satu sama lain. Walau bagaimanapun, hanya kemahiran bukan teknikal dan pengetahuan BIM yang didapati mempengaruhi kebolehpasaran

siswazah dengan ketara. Temu bual berstruktur menunjukkan bahawa kemahiran teknikal BIM adalah penting untuk kebolehpasaran. Oleh itu, kajian ini sangat penting dalam mengenal pasti cara untuk meningkatkan kebolehpasaran siswazah seni bina dalam industri pembinaan, terutamanya bagi projek BIM. Hasil kajian menunjukkan kemahiran BIM yang perlu menjadi keutamaan siswazah sepatutnya disepadukan dalam silibus politeknik. Dari sudut pandangan pelajar dan majikan, latihan yang lebih praktikal dan pengalaman kemahiran pembinaan di tapak kerja perlu dititikberatkan demi mengasah kemahiran BIM dalam kalangan pelajar serta meningkatkan keyakinan mereka dalam pelaksanaan BIM dengan berkesan.

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ABSTRACT

Building information modelling (BIM) is a new approach for improving the construction industry towards the industrial revolution 4.0 (IR 4.0). The benefit and the efficiency of BIM technology to the industry will contribute to the growth of construction and project thus provide more employment to Malaysian polytechnic graduates. Previous studies on BIM have focused on implementation and barriers in the application of BIM to the education and construction industries. Few studies have addressed how BIM skills and knowledge have influenced the recruitment of new employees in the industry. This study aims to determine the levels of BIM-related skills among architecture graduates. This study also investigates which of the BIM skills can best predict the architecture graduates' employability and the skills demanded by employers. A quantitative approach was applied as the main research design. A qualitative approach via personal interviews was added to support the survey findings. Descriptive and inferential statistics using correlation and regression were used to analyse the quantitative data, and thematic analysis was used to analyse the qualitative data. The findings indicate that the level of BIM skills among the architecture graduates was moderate. All the variables were found to have a significant positive relationship with each other. However, only nontechnical skills and BIM knowledge were found to significantly affect the graduates' employability. The structured interviews show that BIM technical skills are important for employability.

Therefore, this study is essential as it identifies ways to improve architecture graduates' employability in the construction industry, particularly for BIM projects. The findings can suggest the BIM skills that need to be prioritised by the graduates and can be included in the polytechnic's syllabus. From both the students' and employers' viewpoints, more practical training and on-site construction experience are necessary to boost the students' BIM skills and increase their confidence in implementing BIM successfully.

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter provides the background of the study. The problem statement, along with the research objective and research questions, are illustrated. This research study will explore the employability skills of architecture graduates from polytechnics in Malaysia, focusing on building information modelling (BIM).

Section 1.2 will explain the background of the study. The statement of the problem and gaps is discussed in Section 1.3 and 1.4. The research aims and objectives of the study are stated in Sections 1.5 and 1.6. Section 1.7 states the research question, while the scope and limitations of the study are explained in Section 1.8. The significance of the research is established in Section 1.9, and Section 1.10 will briefly explain the key terms used in this study.

1.2 Research Background

The construction industry has grown with numerous development projects that offer both challenges and various opportunities. There is much supply and demand in the construction fields to meet the industry's needs. A new era of building information modelling (BIM) is aimed at improving the industry's development in line with the government's need for better quality, cost-effectiveness, and time management in construction projects' delivery. Currently, BIM is known as a collaborative tool in the architecture, engineering, and construction (AEC) industry. According to Mohd & Ahmad Latiffi (2013), BIM is a digital tool that helps the AEC industry to manage projects effectively, improve the planning process, and design construction activities. The BIM tools can facilitate the AEC industry's increasing productivity and

performance by saving time and cost as well as solving issues that may arise on site (Al-Ashmori et al., 2020).

The application of BIM in the construction industry help in managing to expediting the timeline of the construction and from delivery from the consultant drawing and progress of construction (Mohd & Ahmad Latiffi, 2013). Usage of BIM application in the project help in time management by using the same software that can produce design, drawing, rendering, construction drawing, and cost that the consultant uses. BIM helps improve communication between architects, clients, contractors, and other relevant parties involved in the project. That's because BIM relies on a single source of the systems: all the relevant information, including modelling, estimates, and design notes, are shared and stored in one place. That indicates that BIM helps in cost savings and improvement of scheduling, cost controls, project coordination, quality control, and risk management. Demand for workers with excellent BIM skills is required in the construction industry because the current situation is crucial to cater to the construction industry's needs (Hodorog et al., 2019; R. A. Rahman et al., 2016a)

BIM was first introduced by Professor Charles M. Eastman fifteen (15) years ago in 1970 (Forbes & Ahmed, 2011). The United States was the first country to introduce BIM in their construction industry (NIMBS, 2007). In Malaysia, BIM was launched by the director of the Department of Public Works (JKR) in 2009, yet an empirical study by Mohd-Nor and Grant (2014) had found that only 20 percent of Malaysia's architecture firms had used BIM in their projects; the remaining 80 percent did not use BIM albeit being aware of the tool and its benefits. Meanwhile, a survey that was conducted by the CIDB (2017) discovered that the 78 percent in Malaysia who has adopted BIM are those from the central region of Malaysia. Notably, architects lead

the way with 42 percent of the industry's professionals using BIM, followed by the engineers with 21 percent. From 2014 to 2017, the number of BIM users in Malaysia had increased.

The multipurpose hall of Universiti Tun Hussein Onn Malaysia (UTHM) was the first project implemented with BIM in Malaysia (Ahmad Latiffi et al., 2013). The uptake of the technology has been increasing in developed countries, such as the United States, Europe, and the Middle East. According to (N. A. Haron et al., 2017), among the developed countries that have adopted BIM in the construction sector are Australia (18–75%), the United States (31%), Europe (16%), Middle East (11%), and India (9%). Malaysia also began to implement BIM in construction projects following the support programmes by the government and the increased awareness of its advantages.

The construction industry in Malaysia is growing rapidly with a high demand for infrastructure and developments in the quest to become a developed country by 2020. Accordingly, the Construction Industry Development Board (CIDB) with the Ministry of Works has taken the initiative to introduce the Construction Industry Transformation Program 2016–2020 (CITP) in order to enhance the growth of construction technology in Malaysia. According to CIDB (2019a), the aim of the CITP 2016–2020 is to advance the technology in the industry and to meet the market demand in the construction industry. Among the major challenges that are being faced by the CIDB are the lack of human competency, a skilled workforce in BIM, and the slow adoption of new technology in the Malaysian construction industry (CIDB, 2019a).

Under the Eleventh Malaysia Plan (2018), the government has outlined three strategies in strengthening Malaysia's economic growth. One strategy is the priority of area B, which is to improve the uptake of innovation and technology. This strategy is in

line with CIDB's key performance indicators (KPIs) to ensure that 70 percent of private and public building projects exceeding RM10 million implement BIM by January 2021. BIM Level 2 was introduced by Q4 2020 100 percent for all public building projects exceeding RM100 million (for construction projects JKR) (CIDB, 2019b). BIM has become an essential tool in the construction industry, and the need for competent human resources is currently a priority for the construction players.

Towards meeting the targets, the government has been focusing on generating employable graduates, hence, a better human capital. One strategy in the Eleventh Malaysia Plan is to prioritise the quality over the quantity of Technical and Vocational Education and Training (TVET) (Eleventh Malaysia Plan, 2018). Polytechnics and College Community are one of the largest TVET programmes with 55 percent and 9 percent under the Ministry of Higher Education (MoHE) that focus on producing TVET graduates Ministry of Education Malaysia (2018). Polytechnics are seen as institutions that produce semi-skilled workers who can cater to the industry's demands. Such efforts indicate that MoHE has taken measures to ensure that the polytechnic institutions supply employees, particularly semi-skilled workers, who can meet the construction industry's demands.

The issues and challenges in the TVET program arise from the mismatch in the industry's demand with the supply of graduates towards human capital 4.0. The industry now expects graduates to be a complete package- equip with knowledge, skills as well as good social skills and attitudes, rather than just a focused on specific subjects (Ministry of Education Malaysia, 2018). TVET 4.0 Framework 2018-2025 seeks to generate industry-fit graduates with highly skilled TVET graduates that support IR4.0

by producing highly employable graduates who are competent in technical skills as well as soft skills.

Six (6) polytechnics in Malaysia provide a Diploma in Architectural Programme to enhance graduate skills to generate semi-skilled labor in this architectural field (Department of Polytechnic and Community College, 2018). Most architecture students are aware of the critical use of BIM tools in the construction industry. Institutions and organisations have conducted many training programmes and seminars to expose the graduates to the important use of BIM. This BIM was introduced to ensure that the students comply with the necessary employability skills, particularly those related to BIM in the AEC. The ideas of BIM implementation, techniques, and skills learned from the institutions' programmes will enhance graduates' knowledge, skills, and ability of BIM (Manoharan, 2018). Such indicates that polytechnic students have been aware of the importance of BIM in the construction industry. However, developing BIM necessitates a lot of training, cost, time, and industry involvement to produce competent quality graduates with many quantities to fulfil industry needs.

According to Memon et al. (2014), BIM is a programme that not only involves developing a 3D construction model but coordination and envisioning of the actual construction project. The use of BIM will effectively benefit users. The researcher agreed to the fact that BIM has become essential in the construction industry (Adebakin et al., 2015; Chan et al., 2017; Saka & Chan, 2020). Previous research indicates that BIM has become a crucial tool for the future construction industry and may benefit project owners. However, such a trend may be problematic for the users of BIM currently. A recent study by Ahmad Jamal et al. (2019) showed that the Malaysian workforce still lacks the skills, knowledge, and experience related to BIM. To enhance

BIM implementation in the Malaysian construction industry, there is a need to develop human resources with competent skills. These skills should be determined to ensure that graduates are well prepared with those skills.

BIM is a new technology that is thought of as a platform that benefits the building sector. By bringing construction domains into the project lifecycle, BIM technology offers significant advantages. From early conceptual stages through design, building, and operation phases to demolition, BIM can help with the development stage of a project's lifecycle. According to several researchers, the application of BIM has been linked to improved production and increased efficiency (Al-Ashmori et al., 2020). Many advantages of BIM exist for environmentally friendly buildings, and BIM itself has the potential to boost productivity. BIM refers to the entire construction process, including application, design, management, documentation, and collaboration (Moreno et al., 2019). The project will benefit from it during the whole construction duration. The usage of BIM is advantageous for the entire project team, including the designer, engineer, contractors, and owners, in terms of management, cost savings, and time savings.

1.3 Problem Statement

With globalisation, Malaysia’s construction industry has become more stable and has continued to grow. While the government has proposed new initiatives to boost the construction industry towards the fourth industrial revolution (4IR) the recent Malaysian Construction Industry Transformation Program 2016–2020 (CITP) presents further efforts to align the construction industry’s evolving technologies. One of the recent endeavours is to develop a digital construction and Industry 4.0 roadmap with the national agenda to guide the construction industry towards a digital future (CIDB,

2019b). The Public Works Department (PWD) and the Construction Industry Development Board (CIDB) with MyBIM are the organisations that are focusing on fulfilling the government's missions. Implementing BIM in each construction firm in Malaysia was seen as a way of accelerating construction growth. One of the targets of CIDB is to use BIM Level 2 by Q4 2020 for all public building projects above RM100 million (100%) (including hospitals and schools for JKR development projects) (CIDB, 2019b). However, many obstacles were encountered by the industrial players in the attempts to fully implementing BIM in the construction industry. Some of the main that have been challenges encountered are as follows:

i. Building Information Modelling

BIM is a cutting-edge tool utilised in the construction industry. According to CIDB (2017)'s "Malaysia Building Information Modelling Report," just 18.6% of construction players will apply BIM in Malaysia within the first year; however, this percentage is anticipated to rise to 39.3% in three years and 37.5 percent in five years. Only 4.6 percent of respondents reported having no interest in using BIM. It is a promising beginning and step in the right direction for the successful implementation of BIM in Malaysia (Ibrahim, Shariff, et al., 2019). The Malaysian education industry is worried about the students and graduates, who are future construction employers who will need to hire more valuable professional graduates. This is because sufficient human resources and essential skills are crucial for a developing nation like Malaysia in this digital era (Hj Kamarazaly et al., 2018).

BIM saves time and costs through enhanced efficiency, clearer communication, collective efforts, more accurate design estimates, and fewer design changes (Y. F. Wang, 2013). More than half (58%) of the organisations said using BIM reduced costs

by resolving disagreements, and almost half (48%) said it enhanced project quality by reducing risk and improving predictability (McGraw Hill Construction, 2012). BIM enhances decision-making, worker safety, operation, and maintenance, reducing change orders, claims, litigation, and uncertainty. Using BIM on projects encourages collaboration from all contributors and organised sharing of ideas and information. BIM enhances task quality, product quality, information sharing, and job efficiency.

There is a need to use BIM in construction projects to achieve goals and benefit sustainable construction. BIM can be used in various project lifecycle phases (planning, design, construction, operation, and demolition) (Ahn et al., 2016; Y. Wang et al., 2013). BIM produces a digital model that includes design (3D), scheduling (4D), cost (5D), and lifecycle analysis information (6D) (Y. F. Wang, 2013). BIM helps architects and engineers analyse design possibilities and generate 2D drawings from 3D models. The information can be transferred quickly and enhances collaboration among construction players for 3D visualization and communication to help minimize errors, and omission in documents, reduce rework and decrease design time. BIM also helps improve productivity, reducing rework, schedule compliance, and decreasing change orders due to plan conflicts (Moreno et al., 2019).

ii. Graduates Technical Skills in BIM

The Malaysian government is aware of the evolution of BIM technology in the construction industry. As an initiative, CIDB has presented a policy to implement BIM level 2 for government projects, in particular for all private and public sectors that are over RM100 million by 2020. This policy is one of the government's steps to ensure that all construction players in the industries use BIM. Yet, according to Ahmad Latiffi et al. (2016), the number of construction firms in Malaysia that is adopting BIM is still

low due to the inherent challenges and problems. The study by Yusuf et al. (2017) have found that a qualified BIM workforce is crucial for the industry to implement BIM. The production of skilled graduates' expertise in BIM is very low from the higher education level. Correspondingly, a recent investigation by Ahmad Jamal et al. (2019) have found that workforce skills, knowledge, and BIM experience are still at the low level.

The challenges with regard to the future of BIM include technology, processes, and people (Musa et al., 2018). Several researchers (Ahmad Jamal et al., 2019; Ali Abbas et al., 2016) have identified the main challenges to include the people factor; the shortage of professional and trained BIM workers has imposed a challenging learning environment and a high cost of implementing BIM. Other studies (Abd Hamid et al., 2020; N. F. Azmi et al., 2018) have indicated that the shortage of technical expertise in BIM-related projects is one of the main challenges an architectural firm encounters in implementing BIM. There only 18.6% of construction player in the industry that apply BIM.

iii. BIM Knowledge

Preparing BIM education is crucial to ensure that potential BIM talents have an in-depth awareness of the knowledge, skills, and training that are required to work on BIM-related projects (Ibrahim, Esa, et al., 2019). Mari et al. (2019) have found that employers and graduates have generally agreed that the adequacy of theoretical, construction knowledge, and soft skills are essential in the industry. A survey study by CIDB (2017) in Malaysia has found that 45 percent of its respondents have claimed that they have knowledge in BIM while another 55 percent of the respondents have claimed to lack knowledge of BIM. Therefore, graduates need to be equipped with BIM-related

knowledge and skills for them to follow the BIM requirements (Olugboyega & Windapo, 2019).

The demand for BIM in the construction industry has increased since CIDB made plans to encourage the uptake of BIM among construction industry players. Therefore, Malaysia should improve its BIM education system in order to build a workforce that can serve BIM-related projects (Ibrahim, Esa, et al., 2019). As found by Yusuf et al. (2017), industrial players have raised the need to focus on BIM education and training through a structured university education, industry workshops and conferences, on-the-job trainings, and online media trainings. Another study by N. A. Haron et al. (2017) concluded that the lack of knowledge and readiness to change was one of the obstacles to implementing BIM.

iv. Employability skills

In a challenging economic situation, much preparation is needed for graduates to compete in a job hunt. Graduates need to equip themselves with the necessary employability skills to meet employers' satisfaction (Saleh & Lamsali, 2019). A recent study by Mari et al. (2019) found an agreement between employers and graduates that the latter are not adequately prepared for jobs and lack practical skills. Correspondingly, Maina and Daful (2017) found that students typically exceeded the number of skills learned in the institution but did not meet employers' expectations, who require the latter to be experienced with the actual work situation and environment. Employability skills and knowledge are currently required to meet employers' expectations (Adebakin et al., 2015; Kaushal, 2016). However, according to Dibeh et al. (2019), there is an employability and skills mismatch in the labour market. The current study, therefore,

seeks to identify the mismatch between the skills required by employers and the skills acquired by graduates.

Employability skills are essential for acquiring, keeping, and performing well on a job (Shafie & Nayan, 2010). The growth of an educated global population has imposed significant pressure on employers to identify and recruit candidates with the right mix of technical and employability skills (Md Saad & Ab. Majid, 2014). Twenty-first-century employers seek for graduates who are competitive in the global currents. They look for highly competitive candidates who can adapt to the industry's rapid changes rather than just having good academic achievement (Mohamad Sattar Rasul et al., 2012; Selvadurai et al., 2012; Zaharim et al., 2010). Due to the fluctuations in job markets after globalisation and the economic crisis, the traditional ways of entering and sustaining competitive job markets have disappeared, and employers have changed their ways of filling vacancies. Before these global events, holding a higher degree with subject-relevant knowledge and skills was sufficient to gain an entry-level job. Today's employers expect employees to possess relevant personality traits and employability skills to accommodate the ever-changing work demands (Buntat et al., 2013; M. Y. Husain et al., 2013; Messum et al., 2015; Zaharim et al., 2009).

Students are expected to learn faster than before, particularly in technical (hard) skills and soft skills as these skills are necessary to succeed in the workplace (Eaton & Kleshinski, 2013). One study by Maina and Salihu (2016) found the necessity of transferable and personal skills in architecture graduates to facilitate their securing an employment. Soft skills were considered by employers to be important for employability compared to technical/hard skills (M. A. Haron et al., 2019; Succi & Canovi, 2020). The employers believe that the workforce needs to change its quality

and aptitudes; the executives argued that employability is a greater test than unemployment. To address such demands, employability has become more important than job security. Hence, employability is one of the most researched areas concerning today's workforce (Md Saad & Ab. Majid, 2014).

v. Graduate Employability

The shortage of talented semi-skilled workers may affect the construction industry's future in terms of productivity, project performance, and economy (Utting, 2010). To cater to the industry's demand, there is a need to prepare graduates to become semi-skills workers.

Enhancing graduates' employability is a priority to the TVET institution. The increasing number of technical graduates who are not getting jobs has become a problem. The unemployment factor is a problem due to the lack of jobs and the existence of a mismatch between the skills that are required by the labour market and the skills that are possessed (skill mismatch) (Mohamad Satar Rasul et al., 2009). According to Tan et al. (2017), there is a mismatch between supply and demand in graduates' employability. The rapidly evolving technology has also resulted in a mismatch between the industry's needs and the supply of graduates in the TVET program. TVET institutions are stride strategically to enhance graduates' marketability through competencies enhancement of certain competencies that provide competitive advantages in technical skills and soft skills (Ministry of Education Malaysia, 2018).

1.4 Gaps

Most students are aware of the existence of BIM in the construction industry (Mamter et al., 2014). However, they lack exposure to BIM functions and operations in

the actual scope of work. Most education institutions have introduced BIM software to students, which contradicts the collaborative nature of BIM. There is a need for a much better alignment between the educational sector and accreditation bodies or practice communities so that the next generation of students can be equipped with relevant BIM skills (Rogers et al., 2015).

Such necessitates a study on the level of skills and competencies among students to identify the gap and evaluate the extent to which the current curriculum level has met the industry's expectations (S. H. Husain et al., 2017; Salleh et al., 2013). Identifying graduates' level of skills will allow narrowing the current gap in graduates' skills and competencies. An empirical study can identify the skills required by the employers in specific industries (C. C. Lee & Chin, 2017). As Rosli et al. (2016) suggested, there is a need to expand research on architecture students from other educational institutions, particularly through interviews with experts or focus-group discussions to derive beneficial outcomes.

Most of the previous research was carried out to determine the employability of polytechnic graduates, but little has been researched on architecture students and their BIM-related skills. The current study intends to fill this gap by identifying BIM-related skills among polytechnic architecture graduates and determine their BIM skills and whether they affect their employability.

1.5 Research Aims

This research aims to determine the skill level of BIM, how BIM skills can predict to graduate employability and BIM skills demand by employers that influences the employability of architecture graduates from Malaysian polytechnics for a good supply to industry.

1.6 Research Objectives

The objectives of this study are:

i. To determine the level of BIM skills acquired by Diploma Architecture graduates from Malaysian polytechnics.

ii. To identify which BIM skills can best predict the employability of architecture graduates from Malaysian polytechnics.

iii. To investigate the BIM skills demanded by employers from polytechnic architecture graduates.

1.7 Research Questions

The study attempts to answer the following questions:

i. What is the current status of BIM skills acquired by Diploma Architecture graduates from Malaysian polytechnics?

ii. To extent to how BIM skills (BIM technical skills, nontechnical skills, and BIM knowledge) can best predict contribute the graduates' employability?

iii. What are the BIM skills demanded by employers from polytechnic architecture graduates?

1.8 Research Framework

Employability Skills among Malaysian Polytechnics' Architectural Graduates Involving Building Information Modelling (BIM) Intensive Training

A Quantitative Research Design

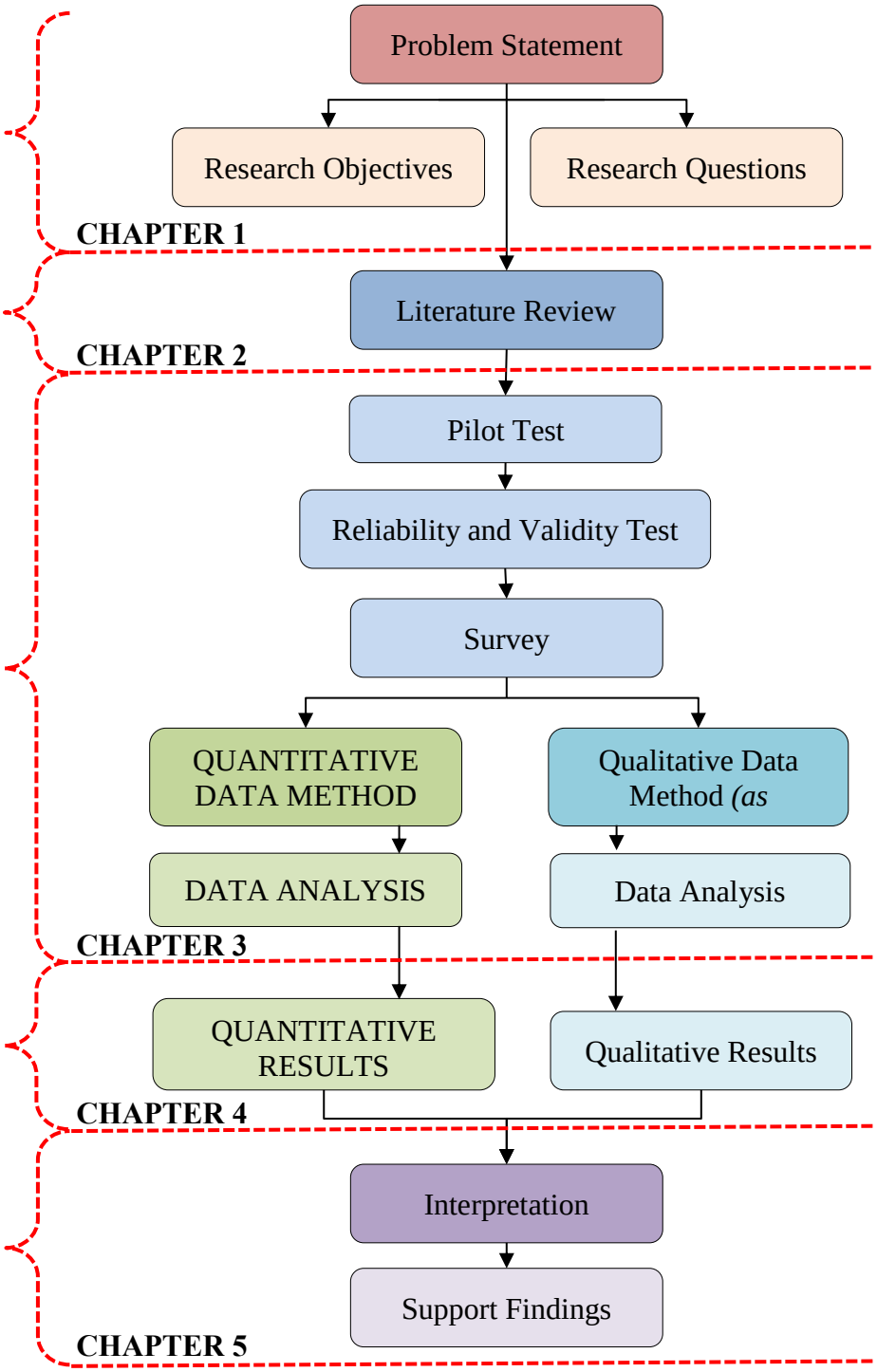

Figure 1.1 Research Framework

1.9 Scope and Limitation of Research

The research focused on examining whether the skills garnered by architecture graduates from polytechnics are aligned with employers' demands in the BIM construction industry. Polytechnic graduates are known to be semi-skilled workers. This research focuses on the students who graduated from session December 2019 and are currently looking for a job. A questionnaire survey was carried out in six Malaysia polytechnics offering a diploma in architecture programme.

A semi-structured interview was carried out to determine the BIM skills demanded by the industry from employers' viewpoints. The semi-structured interviews involved the employers of architecture firms that are registered with the Board of Architect (LAM), have been involved with BIM for more than five (5) years, and have had experience hiring graduates from polytechnics.

This research is not a national project and was undertaken with limited time and financial constraints. Therefore, it is not feasible to include many graduates in the survey. Also, as BIM is still new in Malaysia; it might be hard to obtain cooperation from architectural firms and government agencies for interviews.

1.10 Significance of Research

Past studies have investigated employability skills but do not focus on the needs of BIM skills for the BIM market in the context of architectural-level diplomas. Most past studies have examined employability skills in fields other than architecture. The present study focuses on the necessary BIM skills—such as BIM technical skills, nontechnical skills, and BIM knowledge—required for the marketability of architecture graduates, particularly from polytechnics.

The present study focuses on enhancing the employability of polytechnic graduates to compete for future jobs in the construction industry, particularly in BIM. The construction industry is growing rapidly; therefore, the graduates need to improve their skills in order to be competitive. The information gained from this study can be used to identify the problems and issues with regard to polytechnic graduates' employability. This study hopes to highlight the competency of the graduates, particularly architecture graduates, in BIM-related skills. The research is necessary to increase the employment rate, hence achieving the Ministry of Higher Education's vision of "to be an excellent TVET institution in line with industrial needs."

It is hoped that the findings can support the construction industry's aspiration to develop competent workers who can meet the demands of BIM projects. According to previous Malaysia's minister of education (2019), the quality and delivery of TVET programmes need to be increased to improve graduates' marketability, particularly through an industry-building approach.

1.11 Key Term Definitions

The key terms used in this study are defined as follows:

1.11.1 Building Information Modelling (BIM)

Building information modelling (BIM) is a tool for AEC to generate data and information from conventional drawing methods into more proper methods.

1.11.2 Architectural Polytechnic Graduates

Architectural polytechnical graduates refer to the Diploma in Architecture graduates from a polytechnic in Malaysia. This means that polytechnics confer students a diploma at the convocation ceremony.

1.11.3 Employability

Employability refers to graduates' ability to get a job, maintain a job, and even get a new job if needed with their skills and get paid for the work.

1.11.4 BIM Skills

BIM skills include technical skills, nontechnical skills, and knowledge that graduates acquire from an institution for employment in the BIM construction industry.

1.11.5 BIM Technical Skills

Technical skills are the skills that are more specific to the field of work.

1.11.6 Nontechnical Skills

Nontechnical skills are skills that involve soft skills and generic skills to get a job and work.

1.11.7 BIM Knowledge

BIM knowledge refers to the theoretical and technical knowledge involved in BIM for working.

1.12 Organisation of Thesis

There are five chapters of this thesis.

Chapter One presents an overview of the research background and problem statement of the overall study. The chapter highlights the relationship between skills and knowledge required for implementing BIM in the construction industry. It also emphasises the importance of skills and knowledge for graduates' employability. The research question and the objectives of the study are addressed to achieve the research aims. The significance of the study is outlined both in theoretical and functional terms and its potential contributions to the body of knowledge. The chapter also explains the

research scope and limitation in the study, the definitions of key terms, and the chapter arrangement.

Chapter Two reviews the relevant literature on the factors that affect graduates' employability. Related theories are also discussed, followed by a discussion on graduates' skills and employability in the construction industry. The relationship between skills and employability is also discussed and presented in the conceptual framework.

Chapter Three discusses the research methodology adopted for the study. It includes the research philosophy, the research approach, the research design, the research strategy, the research process, and the data collection techniques. Then this chapter explains the populations and sampling, which includes the sampling techniques and the sample size. The study adopted a semi-structured interview for the qualitative part and a questionnaire survey for the quantitative part of the study. The pilot test, along with the reliability and validity test, is explained in this section. The chapter also reports the analysis methods.

Chapter Four reports the data analysis result from SPSS and ATLAS.ti8. This chapter reports the findings with regard to the objectives and research questions addressed in this study.

Chapter Five summarises the findings. This chapter thoroughly examines the research outcomes concerning prior studies and emphasises the important contribution of this study. The chapter presents significant findings and addresses the consequences of the study in a theoretical and practical context. Recommendations are made with regard to future research on BIM employability skills

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews previous studies on the skills that affect the graduates' employability, including related theories. It explains employability skills, BIM technical skills, and BIM knowledge. The chapter also provides an overview of BIM and polytechnic architecture graduates. The chapter discusses the study's conceptual framework and research hypotheses based on the literature review.

2.2 Polytechnic Education

In Malaysia, Technical and Vocational Educational Training (TVET) began at Politeknik Ungku Omar in Ipoh under the United Nations Development Plan in 1969. TVET was approved following the Cabinet Committee for Education's approval in 1979 and the first National Urban master plan (1985–1995). The proposal had led to more polytechnics and extended studies programmes for engineering, trade, and services, including the funding of the Cabinet Committee's endorsement of the training (1991).

On March 26, 2010, the Council of Ministers signed a memorandum from the Minister of Higher Education to set up ten (10) METrO polytechnics consisting of four polytechnics in the Ninth Malaysian Plan, and six (6) polytechnics in the Tenth Malaysian Plan. Today, there are currently 36 polytechnics and 103 colleges under the TVET programme (Department of Polytechnic and Community College, 2020). The same report also notes that in 2020, 26,420 students enrolled in full-time diploma programmes at six polytechnics compared to 28,998 students in 2019. These statistics indicate that only 17,834 students enrolled in engineering, manufacturing, and

construction programmes compared to 20,291 students in 2019. The total output of graduates for 2020 (5,922 graduates) was 5,483 graduates, which is fewer than 2019. Table 2.1 shows the student enrolment statistics by (i) diploma, (ii) output, and (iii) the engineering, manufacturing, and construction field of study in six polytechnics for 2019 – 2020.

Table 2.1 Statistic Enrolment Student in Malaysian Polytechnic

Polytechnics	Year	Diploma	Engineering, Manufacturing and Construction	Output
PUO	2020	6,171	4,072	1,395
	2019	7,022	4,860	1,335
POLISAS	2020	5,407	3,635	1,156
	2019	6,062	4,154	1,390
POLIMAS	2020	2,175	3,141	876
	2019	2,437	3,260	645
PPD	2020	5,102	3,313	897
	2019	5,420	4,028	1,203
PMM	2020	4,524	2,464	726
	2019	4,683	2,606	885
PSIS	2020	3,041	1,209	433
	2019	3,374	1,383	464
Total	**2020**	**26,420**	**17,834**	**5,483**
	2019	**28,998**	**20,291**	**5,922**

Source: Department of Polytechnic and Community College (2020b)

2.2.1 Architecture Graduates

Out of the thirty-six (36) polytechnics in Malaysia, six (6) offer a diploma in the architecture programme. The polytechnics offering the programme are Politeknik Ungku Omar (PUO), Politeknik Sultan Haji Ahmad Shah (POLISAS), Politeknik Sultan Abdul Halim Mu'adzam Shah (POLIMAS), Politeknik Port Dickson (PPD), Politeknik Merlimau Melaka (PMM), and Politeknik Sultan Idris Shah (PSIS). As of October 2018, 537 total intakes were recorded for the programme; 1,502 students enrolled in the programmes; and 459 graduated in 2018 (Department of Polytechnic and Community College, 2018). These findings indicate that the polytechnics have been producing a considerable number of graduates per year to be employed in the industry

as semi-skilled workers. Table 2.2 shows the total number of architecture students registered in 2018.

Table 2.2 Statistic of Architecture Student in Six (6) Polytechnics

Diploma	Intake	Enrolment	Output	Total
Architecture	537	1,502	459	2,498

Source: Department of Polytechnic and Community College (2018)

2.2.2 Polytechnic Graduates' Employability

Table 2.3 shows the status of employability of polytechnic graduates for 2018 to 2020. A decrease is noted in the number of graduates employed after graduation from 2018 to 2020 compared to the previous year. Hence, there is an increment in the total number of graduates who had secured an employment from 2017 to 2020. Also noted is that most of the graduates furthered their study after the diploma. The number of those waiting for job placement after graduation increased from 2018 to 2020. A major increment is also noted in the number of graduates being unemployed after graduation for 2020 compared to the previous year. The problems may be due to the pandemic at that time.

Table 2.3 Graduates' Employability Percentage from 2016 to 2020

Year	Graduate Status				
	Employed	Further Studies	Enhanced Skills	Waiting for Job Placement	Unemployed
2020	17,921 (69.2%)	4,932 (19.0%)	75 (0.3%)	749 (2.9%)	2,224 (8.6%)
2019	21,305 (81.2%)	3,669 (14.0%)	67 (0.3%)	324 (1.2%)	871 (3.3%)
2018	21,502 (83.9%)	2,805 (10.9%)	47 (0.2%)	291 (1.1%)	998 (3.9%)
2017	17,334 (77.8%)	2,797 (12.5%)	171 (0.8%)	752 (3.4%)	1,234 (5.5%)
2016	16,593 (71.2%)	3,102 (13.3%)	583 (2.5%)	394 (1.7%)	2,646 (11.3%)

Source: MoHE (2020)

Despite the increase in the percentage of graduates' employability from year to year, the data offers no specific detail on which field is performing or underperforming. The current study therefore intends to determine the level of BIM-related skills that have influenced the employability of architecture graduates from Malaysian polytechnics.

2.2.3 Evolution of BIM Tools in Polytechnic

Most students used AutoCAD, Sketch Up, and other tools to create concepts and models before BIM tools were introduced. The students carried out the modelling with the help of the program. Since 2014, the Polytechnic education system has adopted BIM tools more extensively to meet market demands. The use of software to generate the design and model easily and quickly with the BIM. Then, the curriculum integrated Revit Structure and Revit MEP to enhance students' skills. In line with the students' exposure to BIM software, the most recent curriculum has elevated the building information modelling feature from the present course to LOD 200 from the prior curriculum (JPPKK, 2019). The tools generate drawings in 2 dimensions (2D) and 3 dimensions (3D), saving time while creating the model.

The growth of BIM tools in polytechnics increased through introducing and raising student awareness through competitions using BIM software and proficiency training (Ali et al., 2016). The competition was introduced to the students to arouse their curiosity and develop their abilities to utilise more BIM tools. Students can learn about the benefits of BIM technologies through a variety of competitions, including the BIM Marathon, the Autodesk Malaysia Design Competition (AMDC), and the WorldSkills Malaysia Competition (WSMB) (N. Amiruddin, 2018; New Straits Times, 2015). Polytechnic students are introduced to BIM tools early and in-depth to ensure they graduate with the necessary skills and knowledge. Most polytechnic academia has taken

BIM training to improve their skills. That training indicates the importance of skills among academicians to ensure the students can also master their skills and knowledge.

BIM tools are widely employed in building and education due to industry evolution. BIM tools help designers by automatically converting 2D drawings to 3D models and transferring data between design disciplines (Bynum et al., 2013). That makes using BIM tools for the students more advantageous and time-saving. Malaysian construction technology has shifted to BIM digital construction to improve the sector and the quality of life. Effective BIM project implementation will largely depend on a BIM specialist. (Davies et al., 2017). The use of technology and modelling in the construction industry requires specialisation. BIM adoption in the construction sector is proof of the industry's digital transition, from software solutions and technological improvements to process and management adjustments. Implementing BIM in the construction sector raises awareness of BIM education, training, and the industry's transition to digital construction.

2.2.4 Outcome-Based Education (OBE)

Outcome-based education (OBE) is an educational model for students to demonstrate their knowledge and perform according to the required outcomes (JPPKK, 2019). It is a student-centered approach that focuses on students learning. It starts with a clear picture of what students should know, what they should be able to do, and what desirable attitudes and values are needed to organize the curriculum, instruction, and assessment to ensure ultimate learning. Thus, OBE involves restructuring curriculum and assessment that reflects achievement of high learning order and mastery of learning.

OBE helps students be aware of what they should learn, what they are learning, and the control over their learning. It led to successful student learning and encouraged