DIGITAL SKILLS AND COURSE CURRICULUM OF THE QUANTITY SURVEYING UNDERGRADUATE PROGRAMME IN MALAYSIA

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A project report submitted in partial fulfilment of the requirements for the award of Bachelor of Science (Honours) Quantity Surveying

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DECLARATION

I hereby declare that this project report is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at UTAR or other institutions.

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APPROVAL FOR SUBMISSION

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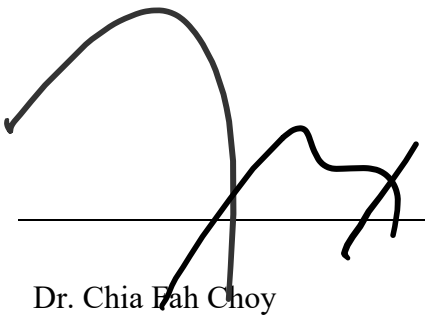
Signature : 

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ABSTRACT

Construction industry had started to shift towards adopting digital technologies over the past decade. The transformation of construction industry will require new skill sets which ought to be embedded in the construction professional's education. Higher education institutions shall prepare their students to acquire the crucial skills for their future employment. What are the digital skills required by quantity surveyors? What are the digital skills included in the course curriculum of quantity surveying undergraduate programme in Malaysia? This research aims to investigate the digital skills that had been imparted in the course curriculum of quantity surveying undergraduate programme in Malaysia. The objectives of this research are to review digital skills embedded in course curriculum of quantity surveying undergraduate programme in Malaysia; to examine the differences in the digital skill set acquired by quantity surveying students and graduates; to assess whether quantity surveying undergraduates and graduates differ in perception towards digital skills acquired and ought to be taught. Five digital skills are identified from the requirement of accreditation bodies and industry. The five digital skills are Data Collection, Data Processing, Data Analysis, Data Ethics and Data Privacy. The methodological choice of this research is mixed mode approach. Questionnaire survey is utilised to collect field data while course curriculum of Universiti Tunku Abdul Rahman quantity surveying programme is reviewed to assess the inclusion of digital skills in the quantity surveying courses. Data collected from 562 quantity surveying students and graduates are analysed quantitative and presented using both descriptive statistics and inferential statistics. The result revealed that quantity surveying students and graduates are more competent in Data Collection while less competent in Data Ethics. Besides that, quantity surveying students and graduates perceived that Data Analysis as the most important digital skill which shall be taught by their higher education institutions while Data Privacy is the least important digital skill. The research is expected to benefit the construction industry, regulatory bodies and quantity surveying higher education providers in improving the course curriculum of quantity surveying education programme to meet the demands of the Malaysian construction industry.

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LIST OF ABBREVIATIONS

BIM	Building Information Modelling
BQSM	Board of Quantity Surveyors Malaysia
CGPA	Cumulative Grade Point Average
CLT	Central Limit Theorem
GDP	Gross Domestic Product
HEP	Higher Education Provider
MQA	Malaysian Qualifications Agency
MQF	Malaysian Qualifications Framework
QS	Quantity Surveying
RICS	Royal Institution of Chartered Surveyors
UTAR	Universiti Tunku Abdul Rahman

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CHAPTER 1

INTRODUCTION

1.1 Background

Construction industry is one of the global economy's greatest sectors which encompasses approximately 13 % of the world's Gross Domestic Product (GDP) (Ribeirinho, et al., 2020). Malaysian construction industry contributed approximately four percent to five percent to the Malaysia GDP from year 2015 to year 2020 (Department of Statistics Malaysia, 2021). Statistics by Department of Statistics Malaysia (2021) also revealed that Malaysian construction industry had contributed nine to ten percent of the employment from first quarter of year 2019 to first quarter of year 2021. World Economic Forum in The Future of Jobs Report 2020 predicted the pace of creation of technology-driven jobs will outstrip the pace of job destruction throughout the next five years and Covid-19 pandemic had expedited the arrival of future of work (World Economic Forum, 2020). Dondi, et al. (2021) had conducted research to identify the future-proof foundational skills which may help the workforce to work in the digital environment and digital skill is identified as one of the four broad skill categories.

Construction industry had started to shift towards adopting digital technologies over the past decade (Swallow, 2020). The transformation of construction industry will require new skill sets and principles of "digital construction" ought to be embedded in the professional's education (Swallow, 2020). This can be seen in the periodic revisions of qualification frameworks by Malaysian Qualifications Agency (MQA) to follow up with the societal changes (Malaysian Qualifications Agency, 2017). Swallow (2020) also suggested that educational institutions shall show their dedication to equipping the professionals with the necessary skills and knowledge to face the rapidly changing construction industry. It will be difficult to teach the skill if it is not being precisely identified (Dondi, et al., 2021). Therefore, higher education institutions shall prepare the students to acquire the crucial skills for their future employment (Yap and Aziz, 2020).

1.2 Problem Statement

Research related to quantity surveying course curriculum and digital skills has been carried out. For instance, Zakaria, Che Munaaim and Iqbal Khan (2006) studied the quantity surveying course curriculum in Malaysia. Nevertheless, the research conducted did not focus on digital skills included in the quantity surveying course curriculum and the research had been conducted more than 15 years ago which may not be relevant anymore. Kwong (2019) studied the necessary competencies to embed Building Information Modelling (BIM) into the quantity surveying education programme, but the research focused solely on BIM without discussing the broader digital skills. Apart from that, research by Yap and Aziz (2020) only discussed the teaching strategies in integrating BIM education in the quantity surveying programme in the Malaysian higher education institution without discussing digital skills. Martzoukou, et al. (2020) studied the university students' self-perceived digital competences for learning and daily usage in three Europe countries. Nevertheless, the study is focusing on Library and Information Science students. Tan (2020) examined the current status of digital talents in the Malaysian construction industry. However, the research is not specifically focused on quantity surveying students and graduates. Previous studies were more focusing on BIM instead of digital skills and quantity surveying course curriculum. The answer of the questions remains unfolded are: What are the digital skills required by quantity surveyors? What are the digital skills included in the course curriculum of quantity surveying undergraduate programme in Malaysia? These questions are planned to be answered in this research.

1.3 Research Aim

The aim of this research is to investigate the digital skills that had been imparted in the course curriculum of quantity surveying undergraduate programme in Malaysia.

1.4 Research Objectives

To accomplish the aim mentioned above, the research objectives are established as follows:

(i) To review digital skills embedded in course curriculum of quantity surveying undergraduate programme in Malaysia.

(ii) To examine the differences in the digital skill set acquired by quantity surveying students and graduates.

(iii) To assess whether quantity surveying undergraduates and graduates differ in perception towards digital skills acquired and ought to be taught.

1.5 Research Scope

The target respondents are the current students who are studying bachelor's degree quantity surveying programme in the higher education institutions of Malaysia. It also includes the graduates of the programme. Students studying diploma in quantity surveying programme from polytechnic institutions are excluded from this research.

1.6 Research Method

The nature of this research is explanatory. The digital skill embedded in the quantity surveying (QS) programme is uncovered by reviewing the course curriculum of QS programme. A typical course curriculum of QS programme offered by higher education institution is used for detail analysed. The QS programme offered by Universiti Tunku Abdul Rahman (UTAR) has been selected in this study as the programme is accredited by both local and abroad regulatory bodies, i.e. Board of Quantity Surveyors Malaysia and Royal Institution of Chartered Surveyors respectively. Besides that, the primary data of digital skill sets acquired from the perspective of students are collected through questionnaire survey. The reliability of the question construct was validated by Cronbach's Alpha Reliability Test. Mann-Whitney U Test and Wilcoxon Signed Rank Test were used to infer the statistically significant findings.

1.7 Report Structure

Chapter 1 is the introductory chapter. It outlined the essential background of digital skills in the construction industry and reviewed previous research

conducted. The research aim and objectives are also being discussed. The research method along with research scope are expounded in this chapter.

Chapter 2 reviewed the literature regarding the fourth industrial revolution and digital transformation in construction industry. It also examined the accreditation bodies' requirement of digital skills in QS programme. Digital skills required by quantity surveyors are identified through analysis of the requirement by accreditation bodies and construction industry. A conceptual framework that integrates digital skills required by quantity surveyors is illustrated.

Chapter 3 explained the research methodology adopted. The research design discussed the research nature and methodological choice. Questionnaire as the research instrument is justified. Sampling design including population, sampling frame, sampling method and sampling size are discussed. Reliability test, descriptive statistics and inferential statistics are adopted in data analysis.

Chapter 4 reported the results and discussed the findings. Course curriculum of an accredited QS programme is being reviewed. Respondents' backgrounds are presented using descriptive statistics. Reliability of data collected is tested by Cronbach's Alpha Reliability Test. Data gathered are analysed and generalised using inferential statistics which are Mann-Whitney U Test and Wilcoxon Signed Rank. The research findings are reviewed and compared with the literature review.

Chapter 5 summarised the research findings. Conclusion is reached on the digital skills and course curriculum of quantity surveying programme in Malaysia. It also outlined the achievement of research objectives and implications of research. Finally, the limitations are discussed followed by the recommendations to enhance quality of future research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter provided an overview of fourth industrial revolution. Besides that, it discussed the digital transformation in the Malaysian construction industry. Requirements of digital skills in QS programme by accreditation bodies including MQA, BQSM and RICS are examined. By comparing the requirement of accreditation bodies and construction industry, digital skills required by quantity surveyors are identified. Finally, a conceptual framework that synthesis five digital skills which are Data Collection, Data Processing, Data Analysis, Data Ethics and Data Privacy is presented.

2.2 Fourth Industrial Revolution

In 2015, Klaus Schwab introduced the concept of fourth industrial revolution and it was characterised by the synthesis of technologies through digital, physical and biological worlds (Schwab, 2016b). The fourth industrial revolution was a novel chapter in human history which equivalent to the previous industrial revolutions and was driven by advanced and remarkable technologies (Schwab and Davis, 2018). It is also evolving at a faster pace than the previous industrial revolutions (Schwab, 2016a). A paradigm shift is afoot in the way we work, live and communicate (Schwab, 2016a) and the shift has impacted many professions in different industries (Tay, et al., 2018). The fourth industrial revolution brought impact to not only the economy and society but also to individuals (Schwab, 2016a). New technologies in the fourth industrial revolution will drastically affect the nature of work throughout all industries including the construction industry.

2.3 Digital Transformation

Digital transformation is the focus in the era of fourth industrial revolution by policy makers as digital transformation is changing how the economy functions (Aly, 2020). Baldini, et al. (2019) defined digital transformation as the extensive changes which take place in both economy and society resulting in the uptake

and integration of digital technologies in all aspects of human life. Digital transformation can also be defined as the integration of digital technology into business which fundamentally changed the way that business operates (Mićić, 2017). The two definitions stated showed that digital technologies are the centre of digital transformation which the uptake of digital technologies had influenced all sectors in the economy and society around the globe (Baldini, et al. 2019). The future of construction industry will be greatly reliant on the adoption of digital technologies (Construction Industry Development Board, 2020). However, the construction industry is being reported lagging behind other industries in the adoption of digital technologies (Baldini, et al., 2019). Recent research in Malaysia which studied the preparedness of digital transformation discovered that although construction practitioners are mindful of the digital trend, they are still not well prepared (Lee, 2020). Notwithstanding the low adoption rates of digital technologies, construction industry is having substantial potential in digital transformation for the whole value chain which leads to enhancement in efficiency and competitiveness (Baldini, et al., 2019). Barbosa, et al. (2017) also discovered that the global productivity in the construction industry has the potential to raise around fourteen to fifteen percent with associated four to six percent of cost savings when infusing digital technologies.

Countries around the globe such as Canada, United Kingdom, Ireland and Singapore had embraced digital transformation in construction industry with respective strategic plans (Construction Industry Development Board, 2020). In Malaysia, Construction Industry Development Board had developed and published the Construction 4.0 Strategic Plan (2021-2025) to unleash the potential and benefits of Construction 4.0. The term Construction 4.0 is coined from Industry 4.0 and is defined as the digitalisation of the construction industry (Osunsanmi, Aigbavboa and Oke, 2018). In the Construction 4.0 Strategic Plan (2021-2025), people is identified as one of the enablers for Construction 4.0. People in the strategic plan is referring to the Malaysian workforce. Without the workforce with the right skills, even with substantial investment in advanced technologies, the effect will still be minimal as only capable workforce can transform the future of Malaysian construction industry. The strategic plan had stressed the importance of equipping our future workforce with the new skills to ensure that they are able to adapt to the fast-changing environment

(Construction Industry Development Board, 2020). This is corroborated by Masduki and Zakaria (2020) which highlighted that workforce nowadays shall be nurtured with the necessary skills to face future challenges. The workforce shall also be responsive to technological changes to ensure the competitiveness of the workforce (Construction Industry Development Board, 2020). There will be a risk for Malaysia to lose the opportunity to transform our construction industry if our higher education systems are unable to produce workforce with the right skills. Construction Industry Development Board (2020) in its strategic plan also pointed out that our education syllabus is not in line with the construction industry's increasing demand. To unleash the potential of digital transformation in the construction industry, workforce shall be equipped with new digital skills. Paucity of skills and knowledge in matching the digital demand has been a prominent issue in the construction industry (Madanayake, Seidu and Young, 2020). Thus, as one of the workforces of the construction industry, quantity surveyors should acquire the essential digital skills to fulfil the demand of the construction industry.

2.4 Requirements of Digital Skills in Quantity Surveying Education from Accreditation Bodies

As highlighted by Construction Industry Development Board (2020), Malaysian education syllabus is unable to meet the needs of the Malaysian construction industry, therefore, it is necessary to review the digital skills requirement in the quantity surveying education from accreditation bodies to ensure quantity surveyors as one of the construction workforces are able to catch up with the fast-changing environment. The accreditation bodies include Malaysian Qualifications Agency (MQA), Board of Quantity Surveyors Malaysia (BQSM) and Royal Institution of Chartered Surveyors (RICS).

MQA is accountable for accrediting and regulating all higher education programmes in Malaysia (Malaysian Qualifications Agency, 2017). There are five clusters of learning outcomes as listed in the Malaysian Qualifications Framework (MQF), namely knowledge and understanding, cognitive skills, functional work skills, personal and entrepreneurial skills, and ethics and professionalism (Malaysian Qualifications Agency, 2017). Digital skill is identified as one of the functional work skills and is defined as "the ability to

use information/digital technologies to support work and studies. The skills include sourcing and storing information, processing data, using applications for problem solving and communication, as well as ethics in applying digital skills" according to the second edition of MQF (Malaysian Qualifications Agency, 2017).

Quantity surveying programme is a professional programme that shall be accredited by professional accreditation bodies including BQSM and RICS. BQSM is the sole body regulating all quantity surveying programmes in Malaysia (Board of Quantity Surveyors Malaysia, 2019). Referring to the Accreditation Manual for Quantity Surveying Programme published by Quantity Surveying Accreditation Council of BQSM, IT and computing are included as the typical elements of a quantity surveying programme (Board of Quantity Surveyors Malaysia, 2019). RICS, the world recognised professional body for surveying professions, identified data management as the mandatory competency which a chartered surveyor should acquire. As defined by Royal Institution of Chartered Surveyors (2018), data management competency covers "how data relating to individual projects and a surveyor's work generally is collected, stored and retrieved".

To sum up, the digital skills requirements from accreditation bodies in the quantity surveying programme are "the ability to collect, store, retrieve and process data for sourcing and storing information, utilise for problem solving and communication along with ethics in utilising digital skills to assist work and studies".

2.5 Digital Skills Required by Quantity Surveyors

Based on the summarised definition of digital skills required by accreditation bodies in Section 2.4, four digital skills are identified which are Data Collection, Data Processing, Data Analysis and Data Ethics. Data Privacy is identified from literatures. The five digital skills are the essential digital skills required by the quantity surveyors.

2.5.1 Data Collection

Bello, et al. (2021) recognised that construction industry is data intensive because different data are created as the project develops. Significant data arise

from various disciplines in the construction industry throughout the project life cycle (Bilal, et al., 2016). According to Uma and Hanumanthappa (2017), data collection is the process that gathers and determines information on aimed variable which eventually help one to obtain relevant answer and assess the outcomes. In other words, data collection is the essential step before one can utilise the data to make decision. Data capture is also part of data collection process which extract the related data when the associated transaction or operation is happening (Butterfield and Ngondi, 2016). Based on DigComp 2.1: The Digital Competence Framework for Citizens published by the European Union, under the information and data literacy, the citizens shall have the ability to browse, search and filter data, information and digital content (Carretero, Vuorikari and Punie, 2018). One shall be able to search, access and navigate the data and information in the digital environment (Carretero, Vuorikari and Punie, 2018). Apart from that, the ability to generate own search strategies is also important for effective data collection (Carretero, Vuorikari and Punie, 2018).

Generally, data collection can be categorised as sourcing information and collecting data. For sourcing information, one should be able to perform web search, to construct strategies for searching information and to use advanced features of search engine to facilitate effective data collection. This can be seen in the research conducted by Adeoye and Adeoye (2017) to assess the digital literacy skills of undergraduate students in Nigeria. The research included knowing what information can be found online, using right tools to search information online and ability to construct strategies to locate information as part of the information literacy skills (Adeoye and Adeoye, 2017). Clifford, et al. (2020) included using keywords to find information needed quickly and taking advantage of advanced features in search engine as the questions to examine the respondents' competencies in browsing, searching and filtering data and information. Research by Igbo (2020) in Nigeria incorporated performing web search using search engines of web browsers as part of the digital literacy skills. Ability to surf internet by utilising different search engines is encompassed in information and data literacy (López-Meneses, et al., 2020). Martzoukou, et al. (2020) highlighted that finding research data online, collecting data using related digital tools, and designing and administering online data collection instruments are also related to Data Collection skill.

Wardhani, Hesti and Dwityas (2019) categorised the capability to recognise required information as one of the information literacies statements.

2.5.2 Data Processing

Raw data is not valuable to the organisation (Duggal, 2021). To turn the data collected into useful information, data processing is needed. Data processing is the process that converts raw data into usable information (Duggal, 2021; Planning Tank, 2021). Oxford University Press (2021) defined data processing as a series of actions that computer executes on data to generate a result. After raw data being processed, it will be presented in a readable and desirable form such as tables and charts which can be understood (Duggal, 2021; Planning Tank, 2021). Data validation or data cleaning shall be completed during data processing. Butterfield and Ngondi (2016) define data validation as the process which checks the data to comply with the specification. The checking process may involve checking the number and type of characters, range of values, correctness and consistency of the data (Butterfield and Ngondi, 2016). According to Carretero, Vuorikari and Punie (2018), the credibility and reliability of the sources of data shall be analysed, compared and evaluated. According to Sharma (2018), the accuracy and adequacy of data collected must be verified before processing. Data with poor quality can lead to less effective decision making and reduced capability in formulating a strategy (Redman, 1998). Data processing can be done either manually or automatically (Planning Tank, 2021). Manual data processing will require more time to process the collected data. Acquiring programming or coding skill enable the user to process the data automatically. Programming involves developing a series of instructions which can be understood by computing systems to resolve a particular problem or carry out a specific task (Carretero, Vuorikari and Punie, 2018). Tan (2020) identified coding as one of the digital competencies required by digital talents. To date, there is still no higher education provider (HEP) in Malaysia providing coding course in their quantity surveying course curriculum. Coding can be useful to develop instructions which understandable by the computer to perform a particular task.

Generally, data processing can be classified as filtering information, evaluating information, organising information and programming. As quantity

surveyors are possessing huge amount of data, they shall have the ability to filter the data collected. Research showed that 13 % of the construction workers' working hours are spent on finding the project data and information which five hours per week being wasted (Snyder, Menard and Spare, 2018). Adeoye and Adeoye (2017) argued that one shall have the ability to filter huge number of search results rapidly and be able to distinguish between the information found. Besides filtering information, quantity surveyors shall also be able to evaluate the information evaluated. When unreliable resources are being utilised, the professionalism of the quantity surveyor will be questioned. Adeoye and Adeoye (2017) stressed the importance of evaluating information collected from multiple sources while Martzoukou, et al. (2020) highlighted the importance of choosing trustworthy information as people tends to believe that results presented by search engine are all authentic. Ability to distinguishing between official and personal sites is also included as part of data processing skill (Wardhani, Hesti and Dwityas, 2019). In terms of organising data collected, Clifford, et al. (2020) highlighted that one should be able to organise data found and to use storage media for storing information. Finally, for programming, Clifford, et al. (2020) included ability to write codes and other simple applications which can be used to perform tasks in assessing the respondents' digital competence.

2.5.3 Data Analysis

Centobelli and Ndou (2019) pointed out having substantial data is useless unless the data is made sense through data analysis. Burger (2019) also has a similar opinion which data is not useful on its own but only useful after being properly analysed. Royal Institution of Chartered Surveyors (2020) reported that approximately 95 % of data in the construction industry is not utilised but wasted. In order to leverage the power of data, analytical skills are vital for construction practitioners (Cook and Chatterjee, 2015). Construction practitioners need to build the ability to deal with the considerable amount of complicated data collected to keep abreast of changes in the digital transformation (Cook and Chatterjee, 2015). According to Plummer, et al. (2021), one should be capable in analysing data through statistical analysis to inform data comprehension. Besides that, the utilisation of visualisation can

enhance the data interpretation and help in decision making (Plummer, et al., 2021).

Data analysis can be classified as analysing data, interpreting data and compiling information. Clifford, et al. (2020) and Martzoukou, et al. (2020) stressed the importance of using software to analyse data and understand how data can be utilised to make decisions. After analysing the data, it is also vital to know how to interpret the data analysed (Martzoukou, et al., 2020). Finally, in terms of compiling information, Wardhani, Hesti and Dwityas (2019) underscored one shall have the capability to compile various information and rewrite them with own words.

2.5.4 Data Ethics

The extensive data collection and data analysis in this data-driven world is bringing up concerns of data ethics. Data ethics concentrates on the ethical problems caused by the collection and analysis of huge datasets (Floridi and Taddeo, 2016). Living in an increasingly transparent world with nearly instant access to data and information, there is a greater than ever need to have the education and standards on ethics (Cook and Chatterjee, 2015). Royal Institution of Chartered Surveyors (2020) reported the ethics of data capture across the built environment requires us to consider the issue of data ethics carefully and act integrity.

Data ethics can be categorised as acknowledging information, copyright of information and data ethics. Adeoye and Adeoye (2017) and Martzoukou, et al. (2020) highlighted the importance of acknowledging information found online. The acknowledgement can be done through proper citation and referencing of the resources being utilised. Copyright of information shall also be aware when establishing what online information may be legally reused and asking for permission before publishing content created by others (Adeoye and Adeoye. 2017; Martzoukou, et al., 2020). One should also be familiar with the legislation regarding data ethics. For instance, Personal Data Protection Act 2010 which utilised in Malaysia to protect personal data in commercial transactions.

2.5.5 Data Privacy

Privacy is also the focus of the public in this data-driven world (Richterich, 2018). In the process of utilising online services, personal data are collected by online services providers. Thus, it is vital to understand how to protect personal data and privacy in digital environments (Carretero, Vuorikari and Punie, 2018). One shall know the way to use and share personal data and protect oneself and others from damages (Carretero, Vuorikari and Punie, 2018). Plummer, et al. (2021) also emphasised the prominence of obtaining consent when using personal data.

Clifford, et al. (2020) suggested that one may protect personal data by refusing access to geographical location and identifying suspicious e-mail which trying to collect personal data. Security of websites that asking for personal data shall also be checked (Clifford, et al., 2020). Settings in internet browser shall be configured to limit cookies that collect personal data (Clifford, et al., 2020). Wardhani, Hesti and Dwityas (2019) stressed that one shall understand the way to protect privacy when performing activities online.

2.6 Course Curriculum Review of an Accredited Quantity Surveying Programme

This section reviewed the course curriculum of quantity surveying programme provided by UTAR. The programme is accredited by both BQSM and RICS. The documents examined are the syllabus and the assignment briefs of 43 courses included in the programme. The purpose of the document examination is to identify the digital skills which had been embedded in the teaching and learning activities of the individual courses. Table 2.1 summarises all the courses offered by the programme which include course classification and digital skills set included in the programme. Elective subject for MQA unit (National Language / Other Language) and University Unit (Co-Curriculum), due to the similar nature, only one of the electives is chosen for review. Full version of quantity surveying courses with associated study activities and their corresponding digital skills classification can be found in Appendix B.

Table 2.1: Quantity Surveying Courses and Digital Skills Provided by UTAR.

Course Name	Course Classification	Data Collection	Data Processing	Data Analysis	Data Ethics	Data Privacy
English for Professional Communications	Compulsory	√	√	√	√	√
Introduction to French	Elective	×	×	×	×	×
Tamadun Islam dan Tamadun Asia	MPU	√	√	√	√	√
Building Material	Core	√	√	√	√	×
Construction Technology I	Core	√	√	√	√	×
Technical Drawing and CADD	Core	×	×	×	×	×
Management Principles	Elective	√	√	√	√	×
Organisation and Human Resource	Elective	√	√	√	√	×
Data Analysis for Business Intelligence	Elective	√	√	√	×	×
Hubungan Etnik	MPU	√	√	√	√	√
Construction Technology II	Core	√	√	√	√	×
Building Services	Non-Core	√	√	√	√	×
Site Surveying	Core	√	√	√	√	×
Economics of the Construction Industry	Core	√	√	√	√	×
Measurement of Building Works I	Core	×	×	×	×	×
Art, Craft and Design	MPU	√	√	√	√	×
Mechanical and Electrical Services	Non-Core	√	√	√	√	×
Construction Financial Practice	Core	√	√	√	√	×
Measurement of Building Works II	Core	×	×	×	×	×
Professional Practice and Procedure I	Core	√	√	√	√	×
Sun Zi's Art of War and Business Strategies	Compulsory	√	√	√	√	×
Introduction to Law and Malaysian Legal System	Compulsory	√	√	√	√	×
Building Structural System	Core	√	√	√	√	×

Table 2.1 (Continued)

Research Methods for Construction	Core	√	√	√	√	√
Measurement of Civil and Infrastructure Works	Core	×	×	×	×	×
Estimating	Core	√	√	√	√	×
Computer Aided Quantity Surveying	Core	√	√	√	√	×
Applied Construction Technology and Maintenance	Core	√	√	√	√	×
Measurement of Building Works III	Core	×	×	×	×	×
Construction Management	Core	√	√	√	√	×
Construction Economics	Core	√	√	√	√	×
Professional Practice and Procedure II	Core	√	√	√	√	×
Industrial Training	Industrial Training	√	√	√	√	√
Construction Law	Core	√	√	√	√	×
Project Management	Core	√	√	√	√	×
Integrated Project	Core	√	√	√	√	×
Current Construction Issue	Elective	√	√	√	√	×
International Construction	Elective	√	√	√	√	×
Digital Construction	Elective	√	√	√	√	×
Value Management	Core	√	√	√	√	×
Property Development	Core	√	√	√	√	×
Professional Practice and Procedure III	Core	√	√	√	√	×
Project	Project	√	√	√	√	√

2.6.1 Data Collection

As depicted in Table 4.1, Data Collection skill is embedded in most of the courses of QS programme. Most assignments and tests required QS students to perform web searches using search engines such as Google or Bing and constructing strategies for searching information. For instance, QS students will use keywords such as staircase when doing assignment for Construction Technology I course. For courses such as English for Professional, Tamadun Islam dan Tamadun Asia, Hubugan Etnik, Quantitative Analysis and Operational Research and Project, QS students are taught to design and administer online data collection instrument such as Google Forms. However, there is lack of guidance on using advanced features of search engines. Therefore, students may not be familiar with the use of Boolean Operators such as AND, OR and NOT or using quotes for exact search which may benefit them in searching for more accurate results. However, UTAR Library had conducted Information Skills Programme in each trimester to assist UTAR students in acquiring information searching skill.

2.6.2 Data Processing

Data Processing skill is also embedded in most of the QS courses as per Table 4.1. QS students will have to filter the required information from a large number of search results. They also have to evaluate the reliability of the information obtained to ensure the information chosen are appropriate and reliable. Assignments and tests require QS students to utilise reliable and reputable updated information. Folders and storage media will be utilised by QS students to organise the information collected. Quantification of data using BIM software can be seen in Computer Aided Quantity Surveying which requires students to export measured quantities from the BIM tools such as Autodesk Revit and Autodesk Navisworks which expedite and ease the quantification works. However, not all courses provide guidance in evaluating and choosing trustworthy information. For example, distinguishing the reliability of website through suffixes of website such as .edu, .gov, .org are more reliable than those websites with .com. There are some lecturers who guide the students to explore reliable websites for completion of assignments or tests. There are very little emphasis to make use of spreadsheets in core QS courses such as Measurement

of Building Works and Estimating. Almost all measurement courses are focusing to use manual measurement with dimension paper and printed drawings to perform taking-off. While Estimating course is still only requiring QS students to perform calculations manually, no topic or activity in the course required the students to experience making use of computer for performing estimation.

2.6.3 Data Analysis

Data Analysis skill is also applied in QS courses as shown in Table 4.1. Data Analysis skill is not just limited to analysing data using computer programme but also applied to selecting the essential information to be included in the content of the assignment. This can be seen in most assignments which require students to analyse the data or information collected not just compiling the data or information without any analysis and discussion. Research related subject such as Quantitative Analysis and Operational Research and Project require students to analyse the data quantitatively using statistical software such as Statistical Package for the Social Sciences. While courses such as Value Management and Integrated Project require students to apply functions in Microsoft Excel to complete the assignment. The examples of skill learned are to forecast data using functions such as What-If Analysis and Forecast Sheet in Microsoft Excel. At the same time, data interpretation is also taught in such courses. For instance, Property Development course taught students how to interpret the quantitative risk analysis performed. However, course such as Professional Practice and Procedure II which deals with tender process and contract administration such as interim certificate, variation order and other contractual matters did not include using computer programme to process the task. Hence, lack of skill to perform tasks like performing auto computation or updating the report in the heavy documentation can be observed in course such as Integrated Project. Apart from that, students are rarely taught how to make use of data for decisions making.

2.6.4 Data Ethics

As depicted in Table 4.1, Data Ethics skill is embedded in QS programme but only emphasise on avoiding plagiarism. Assignments and tests are emphasising

academic integrity which plagiarism is strictly prohibited. Therefore, students are familiar with acknowledging information found online by citing and referencing other's work. However, students are not taught to ask for permission before publishing other's content such as reproducing figures or charts which may infringe on other's copyright unintentionally. There is no course to introduce the relevant laws such as Personal Data Protection Act 2010 in the programme.

2.6.5 Data Privacy

There is lack of guidance on Data Privacy skill in the course curriculum. The students are expected to take personal initiative to learn how to protect their personal data privacy such as limiting cookies from websites when performing web searches and having awareness on how personal data will be collected online.

2.6.6 Summary

In summary, the students have some exposure to the skills in Data Collection, Data Processing and Data Analysis of some courses such as Project, Value Management, Property Development, Integrated Project and more. However, there is lack of exposure to Data Ethics and Data Privacy other than prohibition of plagiarism.

2.7 Proposed Conceptual Framework

Figure 2.1 shows the conceptual framework proposed based on the literature reviewed. Digital skills required for quantity surveyors are identified from requirements from accreditation bodies and literature and formed the digital skill sets. Digital skill sets will be the input for quantity surveying course curriculum. Field study will be conducted, the results will be reviewed and will be input back to digital skill sets.

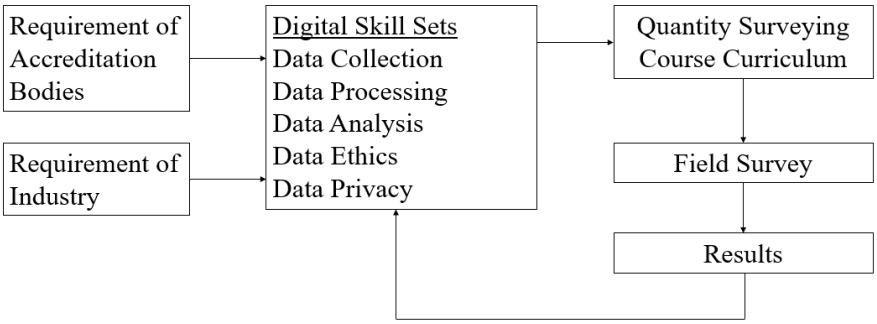

Figure 2.1: Conceptual Framework for Digital Skills and Course Curriculum of Quantity Surveying Undergraduate Programme in Malaysia.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

The chapter discusses the nature of research and methodological choice of this research. It outlines the nature of research in the Research Design. The design of questionnaire and its rationale is explained in the Research Instrument section. The population of this research is defined in the Sample Design section. In addition, the section also elucidates the determination of sample frame, choice of sampling method and sampling size estimation. The last section of this chapter gives an explanation of different data analysis conducted in this research such as reliability test, frequency distribution, mean, mean rank, Mann-Whitney U Test and Wilcoxon Signed Rank Test.

3.2 Research Design

The nature of this research is explanatory. Explanatory research seeks to identify the reasons and consequences of the phenomenon being studied (Sheppard, 2020). This research seeks to explain the different digital skills set that had been imparted in the course curriculum of quantity surveying undergraduate programme, and how the students and graduates perceived them from the receiving end.

The methodological choice of this research is mixed mode approach. The two components adopted in this mixed mode approach are reviewing the course curriculum of UTAR QS undergraduate programme and questionnaire survey. Data collected from questionnaire was quantitatively analysed with statistical analysis software.

QS course curriculum of UTAR is being selected for reviewing because the programme has been accredited by both BQSM and RICS. BQSM and RICS will grant accreditation to the programme if the accredited programme has met the standard requirements laid down by them. In addition, the two institutions represented the local and international authorities respectively.

3.3 Course Curriculum Analysis

43 QS courses provided by UTAR was analysed using the syllabi and assignment briefs to identify the digital skills embedded in the individual courses. The syllabi are downloaded from UTAR portal while the assignment briefs are obtained through Web-Based Learning Environment (WBLE). The following are the demonstration on the methods used for the course curriculum analysis using a QS course known as Property Development.

Based on the assignment brief of Property Development, QS students are required to submit a proposal regarding the suitable type of development and make an offer of residual site value to the landowner for a piece of land located at Selangor. The proposal is a market research report which consists of property productivity analysis, market delineation, demand and supply, equilibrium analysis, forecast subject capture and financial modelling. Students had performed Data Collection skill through activities such as sourcing for selling price of surround properties. Data Collection skill and Data Processing skill were practiced to collect and process cost data required for preparation of development appraisal was obtained from reliable websites such as Arcadis and Building Cost Information Services Malaysia. Risk analysis such as sensitivity analysis and probabilistic modelling was conducted using Microsoft Excel to enable students to practice Data Analysis skill. Finally, Data Ethics skill is applied when students cite the information utilised by using Harvard referencing style.

3.4 Research Instrument

The primary data of this study is collected by questionnaire survey. The questionnaire design consists of three sections. The details are illustrated in the following Table 3.1.

Table 3.1: Questionnaire Design.

Section	Questionnaire Design	Purpose
A	How do you rate yourself in the following competencies?	To evaluate the digital skill acquired by quantity surveying students and graduates.
B	Do you agree that the following competencies should be taught	To assess the quantity surveying students' and graduates' perception towards digital skills

	by your higher education institution?	to be taught by their higher education institutions.
C	Demographic Information	In-depth comparison of responses between attributes of respondents

Section A is designed to evaluate the digital skill acquired by QS students and graduates while Section B is designed to assess their perception towards digital skills ought to be taught by their higher education institutions. All the five digital skills groups, namely Data Collection, Data Processing, Data Analysis, Data Ethics and Data Privacy synthesised in the literature review chapter are represented by the 30 statements in both Section A and Section B. Table 3.2 to Table 3.6 depicted the detail of the digital skills, their subcategories and the corresponding statements asked in the questionnaire and the literature references related of the statements.

Section C is a set of questions related to the respondent's demography data. It consists of academic year, most current cumulative grade point average and current university or university graduated. These data are collected for the in-depth comparison of responses between the different attributes of respondents. A sample of questionnaire can be found in Appendix A.

Table 3.2: Data Collection: Subcategories, Statement and References.

Sub-Categories	Related Statement in Questionnaire	Statement Ref.	Literature Reference
Sourcing Information	Performing web search using relevant search engines (e.g. Google) Constructing strategies (e.g. keywords) for searching information Using advanced features of search engine (e.g. find information with exact word or phase)	A1, B1 A2, B2 A3, B3	1. Adeoye and Adeoye (2017) 2. Clifford, et al. (2020) 3. Igbo (2020) 4. López-Meneses, et al. (2020) 5. Martzoukou, et al. (2020) 6. Wardhani, Hesti and Dwityas (2019)
Collecting Data	Using media-capture devices (e.g. recording on video) Designing data collection instruments online	A4, B4 A5, B5	1. Adeoye and Adeoye (2017) 2. Clifford, et al. (2020) 3. Martzoukou, et al. (2020)

Table 3.3: Data Processing: Subcategories, Statement and References.

Sub-Categories	Related Statement in Questionnaire	Statement Ref.	Literature Reference
Filtering Information	Filtering large number of search results quickly Distinguishing potential information resources	A6, B6 A7, B7	1. Adeoye and Adeoye (2017) 2. Wardhani, Hesti and Dwityas (2019)
Evaluating Information	Evaluating information obtained from different sources Assessing the reliability of online resources Choosing trustworthy sources of information Distinguishing official sites and personal sites	A8, B8 A9, B9 A10, B10 A11, B11	1. Adeoye and Adeoye (2017) 2. Clifford, et al. (2020) 3. Igbo (2020) 4. Martzoukou, et al. (2020) 5. Wardhani, Hesti and Dwityas (2019)
Organising Information	Organising digital information found through folders, bookmarks, tagging Using storage media (eg. USB flash drive) for storing information Recording information found online	A12, B12 A13, B13 A14, B14	1. Adeoye and Adeoye (2017) 2. Clifford, et al. (2020) 3. Igbo (2020) 4. López-Meneses, et al. (2020) 5. Martzoukou, et al. (2020) 6. Wardhani, Hesti and Dwityas (2019)
Programming	Writing codes to automate execution of a task	A15, B15	1. Clifford, et al. (2020)

Table 3.4: Data Analysis: Subcategories, Statement and References.

Sub-Categories	Related Statement in Questionnaire	Statement Ref.	Literature Reference
Analysing Data	Analysing data using software	A16, B16	1. Clifford, et al. (2020)
	Knowing how data are used to make decisions	A17, B17	2. Martzoukou, et al. (2020)
Interpreting Data	Interpreting data analysed	A18, B18	1. Martzoukou, et al. (2020)
Compiling Information	Compiling various information	A19, B19	1. Wardhani, Hesti and Dwityas (2019)
	Rewriting compiled information with own language	A20, B20	

Table 3.5: Data Ethics: Subcategories, Statement and References.

Sub-Categories	Related Statement in Questionnaire	Statement Ref.	Literature Reference
Acknowledging Information	Acknowledging information found online	A21, B21	1. Adeoye and Adeoye (2017) 2. Igbo (2020) 3. Martzoukou, et al. (2020) 4. Wardhani, Hesti and Dwityas (2019)
Copyright of Information	Establishing what online information can be legally reused	A22, B22	1. Adeoye and Adeoye (2017)
	Asking permission before publishing other's content	A23, B23	2. Clifford, et al. (2020) 3. Wardhani, Hesti and Dwityas (2019)
Data Ethics	Familiar with Personal Data Protection Act 2010	A24, B24	1. Martzoukou, et al. (2020)

Table 3.6: Data Privacy: Subcategories, Statement and References.

Sub-Categories	Related Statement in Questionnaire	Statement Ref.	Literature Reference
Data Privacy	Refusing access to your geographical location	A25, B25	1. Adeoye and Adeoye (2017)
	Identifying suspicious e-mail which trying to obtain your personal data	A26, B26	2. Clifford, et al. (2020)
	Checking security of website (e.g. https sites) which asking you to provide personal data	A27, B27	3. Martzoukou, et al. (2020)
	Configuring settings in internet browser to limit cookies	A28, B28	4. Wardhani, Hesti and Dwityas (2019)
	Knowing how online personal data are collected	A29, B29	
	Knowing how to protect privacy when conducting activities online	A30, B30	

Ordinal ranking is expected from the respondents of the questionnaire survey. Numerical values are used to label the respondents' choice and for subsequent data analysis. The following Table 3.7 provides the details.

Table 3.7: Equivalent Numerical Value for Ordinal Ranking of Responses in Section A and Section B of Questionnaire.

Section A: Digital Skills Acquired by Quantity Surveying Students and Graduates	Section B: Quantity Surveying Students' and Graduates' Perception Towards Digital Skills to be Taught by Their Higher Education Institutions	Numerical Value
Fundamental Awareness	Strongly Disagree	1
Novice	Disagree	2
Intermediate	Neutral	3
Advanced	Agree	4
Expert	Strongly Agree	5

3.5 Sample Design

Sekaran and Bougie (2016) defined sampling as the process of selecting the right individuals as the representatives for the whole population. According to Sekaran and Bougie (2016), key steps in sampling includes defining population,

determining sampling frame, determining sampling method and establishing the proper sampling size.

3.5.1 Population and Sampling Frame

The population of this research are quantity surveying students and graduates in Malaysia. It is lack of ready data regarding the population of quantity surveying students in Malaysia. Hence, an estimation of the population is necessary. It was reported that there are 1,456 quantity surveying graduates in 2017 (Board of Quantity Surveyors Malaysia, 2017). If the number of quantity surveying students graduated in each year is assumed to be the same as the number of graduates reported above and the length of career life of a quantity surveying graduates is approximately 30 years, the population of QS will be 43,680. The population will increase to 49,504 if the number of current undergraduates approximately amount to 5,824 (i.e. 1,456 × 4) is included. It can be safely concluded that the population is more than 10,000, hence, the accuracy of the population estimation will not result in significantly difference in sampling size determination as elucidated in Section 3.4.3(a).

3.5.2 Sampling Method

Sampling method can be classified as probability sampling and non-probability sampling (Saunders, Lewis and Thornhill, 2019). This research adopts simple random sampling which is classified under probability sampling. Simple random sampling enables every population element to have an equal chance of being selected to take part in the survey (Sekaran and Bougie, 2016). Simple random sampling can eradicate bias in the data collection process (Saunders, Lewis and Thornhill, 2019).

3.5.3 Sampling Size

Appropriate sampling size is vital to draw a reliable conclusion. The sample size adopted in this research are formula proposed by Cochran and Central Limit Theorem (CLT).

a) Cochran Formula

Cochran formula is adopted as the sample size for the overall research. According to Cochran formula, it is assumed that the confidence level of this research is 95% where Z = 1.96 and the margin of error is 5%. p is assumed as 0.50 to establish a more conservative sample size (Israel, 2012). A sample size of 384 is necessary as shown in the equation (Cochran, 1977):

$$n = \frac{Z^2 pq}{e^2}$$

$$n = \frac{(1.96)^2(0.5)(1-0.5)}{0.05^2} = 384$$

(3.1)

where

n = sample size

Z = level of confidence (Z =1.96 when level of confidence = 95%)

p = the proportion of the population which has the attribute in question

q = 1-p, p = 0.5, q = 0.5

e = margin of error

According to Saunders, Lewis and Thornhill (2019), when the population of research is not more than 10,000, the researcher may adopt a smaller sample size which will not affect the accuracy of the result. The formula for the adjusted minimum sample size is as follow (Saunders, Lewis and Thornhill, 2019):

$$n' = \frac{n}{1+(\frac{n}{N})}$$

(3.2)

where

n' = adjusted minimum sample size

n = original sample size

N = total population

As the estimated population of 49,504 in this research exceeds 10,000, therefore, adjustment for small sample size is not applicable (Saunders, Lewis and Thornhill, 2019).

b) Central Limit Theorem

CLT has adopted to inference the results for comparison between sub-grouping of respondents. Sang and Jong (2017) clarified that when the sample size increases, the sample mean will be distributed normally with the population mean. CLT stated that when the sample size of the research is equal or more than 30, the distribution of the mean will be close to normal distribution (Chihara and Hesterberg, 2018; Saunders, Lewis and Thornhill, 2019). When the representative of the sample increases, the research findings will be more generalisable (Sekaran and Bougie, 2016). In this research, CLT was employed to infer for sub-grouping comparison, for example, the digital skills acquired by QS undergraduates and graduates and their perception towards what digital skills ought to be taught in the programme.

3.5.4 Target Respondents

The target respondents of this research are the QS students and graduates in Malaysia. QS students and graduates from overseas are excluded from this research as their course curriculums may differ from course curriculum of quantity surveying programme in Malaysia.

3.6 Data Analysis

The data from field survey are analysed and presented in the form of descriptive analysis such as frequency distribution, mean and mean rank. In addition, inferential statistics are adopted to identify statistically significant findings in order a generalisable conclusion can be made. The different statisticsal tests applied in this study are Mann-Whitney U Test and Wilcoxon Signed Rank Test.

3.6.1 Reliability Test

Reliability test is adopted to ensure the construct of the questionnaire used in this research are internally consistent. Further tests were examined on the internal consistency of statements included in Section A and B separately.

Furthermore, the statements related to the different skill sets are also being tested separately. The test conducted is to ensure the consistency of the result so that other researchers are able to replicate the result of the findings (Stokes, 2011). The range of alpha coefficient value in the reliability test is between 0 and 1. The alpha coefficient of 0.7 and above will show that the questions are measuring the same thing (Saunders, Lewis and Thornhill, 2019).

3.6.2 Descriptive Statistics

Descriptive statistics such as frequency distribution, mean and mean rank is applied to provide a general impression of the data (Sekaran and Bougie, 2016). Frequency distribution was used to present the respondents' demographic information.

Besides, aggregated mean was adopted to make comparison of grouping of statement in this study, for example, digital skills acquired by the respondents and their perception towards the digital skills ought to be taught by their higher education institutions. The aggregated mean was adopted to transform the non-parametric data to parametric mean for ranking comparison where necessary.

Mean rank is applied to compare the results of Mann-Whitney U Test and Wilcoxon Ranked Sign Test. Mean rank as defined by Minitab (2017) is the average of the ranks for the data within every sample. They are employed in the comparison of digital skills acquired by quantity surveying undergraduates and graduates, the comparison of perception of quantity surveying undergraduates and graduates towards digital skills ought to be taught.

3.6.3 Inferential Statistics

Inferential statistics is the statistics that can be used to establish the relationships among the variables and eventually draw conclusions regarding the population from a sample (Sekaran and Bougie, 2016). Inferential statistics are adopted to ensure the findings are reliable and generalisable. The inferential statistics adopted are Mann-Whitney U Test and Wilcoxon Signed Rank Test.

a. Mann-Whitney U Test

Mann-Whitney U Test is adopted to assess whether quantity surveying undergraduates and graduates differ in perception towards digital skills acquired and ought to be taught. Mann-Whitney U test is adopted to determine whether there are differences between two independent groups on a continuous measure (Pallant, 2020). When the p-value of the statement is less than 0.05, the research hypothesis can be accepted while the null hypothesis can be rejected (Chua, 2016). Pallant (2020) highlighted that statistically significant statement shall describe its difference by using Mean Rank. Effect size for Mann-Whitney U Test is calculated using the standardised test statistic divide by the square root of sample size (Pallant, 2020). The effect size of 0.1 is small effect, 0.3 is medium effect while 0.5 is large effect according to Cohen criteria (Pallant, 2020).

b. Wilcoxon Signed Rank Test

Wilcoxon Signed Rank Test is applied to compare overall digital skills acquired by QS students and graduates and their perception towards digital skills ought to be taught and to compare individual digital skill acquired by QS students and graduates and their perception towards digital skills to be taught.

Wilcoxon Signed Rank Test is utilised to assess the differences between two related samples (Sekaran and Bougie, 2016). Instead of comparing means, Wilcoxon Signed Tank Test transforms scores into ranks, then compares them in first situation and second situation (Pallant, 2020). When the p-value of the paired statement is less than 0.05, it shows that there is significant difference between the digital skills acquired and perception towards digital skills to be taught. Similarly, mean rank is used to report the result for statistically significant statements. Effect size calculation for Wilcoxon Signed Rank Test is the same as Mann-Whitney U Test (Pallant, 2020).

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results of the primary data collected in this research project. It begins with a review of digital skills embedded in course curriculum of an accredited quantity surveying undergraduate programme. The data collected from questionnaire survey are reviewed in the second part of this chapter which included the statistics of the attributes of the respondents who took part in the questionnaire survey, the results of statistic tests conducted such as Cronbach's Alpha Reliability Test, Wilcoxon Signed Rank Test and Mann-Whitney U Test. It highlighted the results of statistically significant results and discussed the findings by comparing the findings with literature reviewed in Chapter Two.

4.2 Respondents' Background

The questionnaire survey is conducted over a period of two and half months from 11 June 2021 to 26 August 2021. 1350 sets of questionnaires were distributed through social media such as Microsoft Team, LinkedIn, WhatsApp and email. A total of 566 quantity surveying students and graduates returned the questionnaire, representing a response rate of 42%. 4 sets of questionnaires are excluded for data analysis as the respondents are studying in or graduated from overseas higher education institutions providing quantity surveying programme. Thus, the number of valid questionnaires is 562 sets. The background of the respondents was shown in Table 4.1. Most of the respondents are Graduated (33.3%), followed by Year 4 (26.7%) and Year 3 students (23.8%). Most of the respondents are studying or graduated from Universiti Tunku Abdul Rahman (39.7%), followed by Universiti Teknologi MARA (12.5%) and Taylor's University (11.9%).

Table 4.1: Attributes of Respondents (N = 562).

General Information	Categories	*n*	%
Academic Year	Year 1	38	6.8
	Year 2	53	9.4
	Year 3	134	23.8
	Year 4	150	26.7
	Graduated	187	33.3
Current University or University Graduated	Universiti Tunku Abdul Rahman	223	39.7
	Universiti Teknologi Malaysia	50	8.9
	Universiti Teknologi MARA	70	12.5
	Universiti Sains Malaysia	23	4.1
	Universiti Malaya	43	7.7
	Universiti Islam Antarabangsa Malaysia	8	1.4
	Taylor's University	67	11.9
	SEGI University	2	0.4
	Infrastructure University Kuala Lumpur	2	0.4
	INTI International University	5	0.9
	Heriot Watt University Malaysia	14	2.5
	University College of Technology Sarawak	39	6.9
	University of Reading Malaysia	2	0.4
	Tunku Abdul Rahman University College	11	2.0
	Universiti Malaysia Sarawak	1	0.2
	Linton University College	2	0.4

Note: N = Total number of respondents

4.3 Reliability of Results

The result of computed Cronbach's coefficient value is depicted in Table 4.2. The overall Cronbach's coefficient value for Section A and Section B and their respective subgroupings are all well above 0.700 which indicate that the related statements use for the subsequent analysis are internally consistent.

Table 4.2: Cronbach's Coefficient Alpha for Reliability Test.

Questions	Number of Items	Cronbach's Coefficient Value
Digital Skills Acquired by Quantity Surveying Students and Graduates	30	0.965
Data Collection	5	0.881
Data Processing	10	0.912
Data Analysis	5	0.895
Data Ethics	4	0.815
Data Privacy	6	0.905
Quantity Surveying Students' and Graduates' Perception Towards Digital Skills to be Taught by Their Higher Education Institutions	30	0.975
Data Collection	5	0.895
Data Processing	10	0.924
Data Analysis	5	0.900
Data Ethics	4	0.859
Data Privacy	6	0.951

4.4 Aggregate Means on Differences Between Digital Skills Acquired and Perception Towards Digital Skills ought to be Taught

As shown in Table 4.3, the perception of quantity surveying students and graduates towards digital skills to be taught in higher education institutions is higher than the digital skills acquired by them.

For digital skills acquired, quantity surveying students and graduates are most competent in Data Collection skill (mean = 3.48) while least competent in Data Ethics skill (mean = 3.09). For perception towards digital skill ought to be taught, quantity surveying students and graduates perceived Data Analysis skill (mean = 4.11) as the most important digital skill ought to be taught in their higher education institutions while Data Privacy skill (mean = 3.94) is perceived to be less important to be taught. Data Ethics skill has the highest mean differences (differences = -0.89) while Data Collection skill has the lowest mean differences (differences = -0.52).

Table 4.3: Differences between Self-assess Digital Skills and Perception Towards Digital Skills to be Taught.

Digital Skills	Self-assess Digital Skills (Mean)	Perception Towards Digital Skills ought to be Taught (Mean)	Mean Differences
Data Collection	3.48	4.00	-0.52
Data Processing	3.40	3.96	-0.56
Data Analysis	3.26	4.11	-0.85
Data Ethics	3.09	3.98	-0.89
Data Privacy	3.25	3.94	-0.69

4.4.1 Mean Rank Differences Between Data Collection Skill Acquired and Perception Towards Data Collection Skill ought to Be Taught

(a) Overall Comparison

The Wilcoxon Signed Rank Test result in Table 4.4 revealed that all Data Collection skill statements were statistically significant at 95 % confidence level. The differences indicated that the perception of quantity surveying students and graduates towards Data Collection skill ought to be taught were statistically significantly higher than the Data Collection skill acquired especially in "*Constructing strategies (e.g. keywords) for searching information*" (A2, B2), "*Using advanced features of search engine (e.g. find information with exact word or phrase)*" (A3, B3), "*Using media-capture devices (e.g. recording on video)*" (A4, B4) and "*Designing data collection instruments online*" (A5, B5). Only "*Performing web search using web browsers relevant search engines (e.g. Google)*" (A1, B1) revealed that rank for skill acquired was significantly higher than the rank of perception towards the skill ought to be taught. The effect size for "*Performing web search using web browsers relevant search engines (e.g. Google)*" (A1, B1) is small effect while "*Designing data collection instruments online*" (A5, B5) has medium to large effect based on Cohen criteria of 0.1 = small effect, 0.3 = medium effect and 0.5 = large effect (Pallant, 2020).

Table 4.4: Comparison between Self-assess Data Collection Skill and Perception Towards Data Collection Skill ought to be Taught.

Self-assess Data Collection Skill	Mean Rank	Perception Towards Data Collection Skill ought to be Taught	Mean Rank	z-value	Effect Size	Asymp. Sig
A1	171.28	B1	167.38	-2.621	0.08	0.009
A2	158.91	B2	179.54	-9.448	0.28	0.000
A3	155.60	B3	179.16	-10.200	0.30	0.000
A4	168.62	B4	184.88	-8.462	0.25	0.000
A5	147.99	B5	206.78	-14.760	0.44	0.000

Note: Refer to Table 3.2 for detail description of the skill acquired and skill ought to be taught.

(b) Data Collection Skill Acquired by Undergraduates and Graduates

The results of Mann-Whitney Test in Table 4.5 revealed that at 95 % confidence level, graduates are statistically more competent than undergraduates in Data Collection skill, especially in "*Performing web search using web browsers relevant search engines (e.g. Google)*" (A1), "*Constructing strategies (e.g. keywords) for searching information*" (A2) "*Using advanced features of search engine (e.g. find information with exact word or phrase)*" (A3) and "*Designing data collection instruments online*" (A5). All statistically significant statements are having small effect size.

Table 4.5: Rejected Null Hypothesis for Data Collection Skill Acquired and Comparison between Undergraduates and Graduates.

Rejected Null Hypothesis	Mean Rank	Effect Size	Asymp. Sig.
"I can perform web search using relevant search engines (e.g. Google)" are the same between			
Undergraduate	271.19		
Graduate	302.17	0.10	0.022
"I can construct strategies (e.g. keywords) for searching information" are the same between			
Undergraduate	266.01		
Graduate	312.57	0.14	0.001

Table 4.5 (Continued)

"I can use advanced features of search engine (e.g. find information with exact word or phrase)" are the same between			
Undergraduate	268.47		
Graduate	307.63	0.12	0.004
"I can design data collection instruments online" are the same between			
Undergraduate	272.07		
Graduate	300.41	0.09	0.041

(c) Data Collection Skill Acquired by Quantity Surveying Undergraduates and Graduates from UTAR

Table 4.6 showed the results of Mann-Whitney U Test which UTAR's QS graduates are statistically more competent in "*Constructing strategies (e.g. keywords) for searching information*" (A2) and "*Using advanced features of search engine (e.g. find information with exact word or phrase)*" (A3) than UTAR's QS undergraduates. The two statements are having small to medium effect size.

Table 4.6: Comparison of Data Collection Skill Acquired by UTAR's QS Undergraduates and Graduates.

Rejected Null Hypothesis	Mean Rank	Effect Size	Asymp. Sig.
"I can construct strategies (e.g. keywords) for searching information" are the same between			
UTAR Undergraduate	107.12		
UTAR Graduate	143.42	0.21	0.002
"I can use advanced features of search engine (e.g. find information with exact word or phrase)" are the same between			
UTAR Undergraduate	108.66		
UTAR Graduate	133.50	0.15	0.029

(d) Comparison between Perception of Undergraduates and Graduates Towards Data Collection Skill ought to be Taught

Results of Mann-Whitney U Test in Table 4.7 disclosed that graduates are statistically having higher agreement than undergraduates towards Data Collection skill ought to be taught especially in "*Performing web search using web browsers relevant search engines (e.g. Google)*" (B1), "*Using advanced*

features of search engine (e.g. find information with exact word or phrase)" (B3), "*Using media-capture devices (e.g. recording on video)*" (B4) and "*Designing data collection instruments online*" (B5). The statements are having small effect size.

Table 4.7: Rejected Null Hypothesis for Perception Towards Data Collection Skill ought to be Taught and Comparison between Undergraduates and Graduates.

Rejected Null Hypothesis	Mean Rank	Effect Size	Asymp. Sig.
"I agree that performing web search using relevant search engines (e.g. Google) shall be taught in my higher education institution" are the same between			
Undergraduate	270.59		
Graduate	303.39	0.10	0.017
"I agree that using advanced features of search engine (e.g. find information with exact word or phrase) shall be taught in my higher education institution" are the same between			
Undergraduate	272.05		
Graduate	300.46	0.09	0.035
"I agree that using media-capture devices (e.g. recording on video) shall be taught in my higher education institution" are the same between			
Undergraduate	266.49		
Graduate	311.61	0.14	0.001
"I agree that designing data collection instrument online shall be taught in my higher education institution" are the same between			
Undergraduate	266.36		
Graduate	311.86	0.14	0.001

(e) Perception Towards Data Collection Skill ought to be Taught by Quantity Surveying Undergraduates and Graduates from UTAR

The p-value for all Data Collection skill statements exceeds 0.05, therefore, it is failed to reject that QS undergraduates and graduates from UTAR are having the same perception towards Data Collection skill ought to be taught.

4.4.2 Mean Rank Differences Between Data Processing Skill Acquired and Perception Towards Data Processing Skill ought to be Taught

(a) Overall Comparison

The Wilcoxon Signed Rank Test result in Table 4.8 revealed that all Data Processing statements were statistically significant at 95% confidence level, except "*Using storage media (e.g. USB flash drive) for storing information*" (A13, B13). The differences indicated that the perception of quantity surveying students and graduates towards Data Processing skill ought to be taught were significantly higher than the Data Processing skill acquired especially in "*Filtering large number of search results quickly*" (A6, B6), "*Distinguishing potential information resources*" (A7, B7), "*Evaluating information obtained from different sources*" (A8, B8), "*Assessing the reliability of online resources*" (A9, B9), "*Choosing trustworthy sources of information*" (A10, B10), "*Distinguishing official sites and personal sites*" (A11, B11), "*Organising digital information found through folders, bookmarks, tagging*" (A12, B12) and "*Writing codes to automate execution of a task*" (A15, B15). Most Data Processing skill statements are having medium effect size only "*Writing codes to automate execution of a task*" (A15, B15) is having large effect.

Table 4.8: Comparison between Self-assess Data Processing Skill and Perception Towards Data Processing Skill ought to be Taught.

Self-assess Data Processing Skill	Mean Rank	Perception Towards Data Processing Skill ought to be Taught	Mean Rank	z-value	Effect Size	Asymp. Sig
A6	160.74	B6	198.15	-13.463	0.40	0.000
A7	175.06	B7	183.80	-12.357	0.37	0.000
A8	171.55	B8	181.94	-11.085	0.33	0.000
A9	159.88	B9	188.99	-11.533	0.34	0.000
A10	169.92	B10	184.08	-11.341	0.34	0.000
A11	168.34	B11	178.15	-6.456	0.19	0.000
A12	179.00	B12	195.13	-5.943	0.18	0.000
A13	195.94	B13	178.20	-1.651	0.05	0.099
A14	169.19	B14	168.20	-6.411	0.19	0.000
A15	122.63	B15	229.75	-16.638	0.50	0.000

Note: Refer to Table 3.3 for detail description of the skill acquired and skill ought to be taught.

(b) Data Processing Skill Acquired by Undergraduates and Graduates

The results of Mann-Whitney Test in Table 4.9 revealed that graduates are statistically more competent than undergraduates in Data Processing skill, especially in "*Filtering large number of search results quickly*" (A6), "*Evaluating information obtained from different sources*" (A8), "*Assessing the reliability of online resources*" (A9), "*Choosing trustworthy sources of information*" (A10), "*Distinguishing official sites and personal sites*" (A11), "*Organising digital information found through folders, bookmarks, tagging*" (A12), "*Using storage media (eg. USB flash drive) for storing information*" (A13), "*Recording information found online*" (A14). All statistically significant statements are having small effect size.

Table 4.9: Rejected Null Hypothesis for Data Processing Skill Acquired and Comparison between Undergraduates and Graduates.

Rejected Null Hypothesis	Mean Rank	Effect Size	Asymp. Sig.
"I can filter large number of search results quickly" are the same between			
Undergraduate	266.68		
Graduate	311.21	0.14	0.001
"I can evaluate information obtained from different sources" are the same between			
Undergraduate	269.19		
Graduate	306.19	0.11	0.007
"I can assess the reliability of online resources" are the same between			
Undergraduate	268.98		
Graduate	306.61	0.12	0.006
"I can choose trustworthy sources of information" are the same between			
Undergraduate	262.94		
Graduate	318.72	0.17	0.000

Table 4.9 (Continued)

"I can distinguish official sites and personal sites" are the same between			
Undergraduate	268.59		
Graduate	307.40	0.12	0.005
"I can organise digital information found through folders, bookmarks, tagging" are the same between			
Undergraduate	265.59		
Graduate	313.41	0.15	0.001
"I can use storage media (e.g. USB flash drive) for storing information" are the same between			
Undergraduate	267.47		
Graduate	309.64	0.13	0.002
"I can record information found online" are the same between			
Undergraduate	265.31		
Graduate	313.96	0.15	0.000

(c) Data Processing Skill Acquired by Quantity Surveying Undergraduates and Graduates from UTAR

Table 4.10 showed the results of Mann-Whitney U Test which UTAR's QS graduates are statistically more competent in "*Choosing trustworthy sources of information*" (A10) and "*Distinguishing official sites and personal sites*" (A11) than UTAR's QS undergraduates. Both statements are having small effect size.

Table 4.10: Comparison of Data Processing Skill Acquired by UTAR's QS Undergraduates and Graduates.

Rejected Null Hypothesis	Mean Rank	Effect Size	Asymp. Sig.
"I can choose trustworthy sources of information" are the same between			
UTAR Undergraduate	108.31		
UTAR Graduate	135.72	0.15	0.021
"I can distinguish official sites and personal sites" are the same between			
UTAR Undergraduate	108.24		
UTAR Graduate	136.20	0.16	0.018

(d) Comparison between Perception of Undergraduates and Graduates Towards Data Processing Skill ought to be Taught

Results of Mann-Whitney U Test in Table 4.11 disclosed that at 95% confidence level, graduates are statistically having higher agreement towards Data Processing skill ought to be taught especially in "*Distinguishing potential information resources*" (B7), "*Evaluating information obtained from different sources*" (B8), "*Distinguishing official sites and personal sites*" (B11), "*Organising digital information found through folders, bookmarks, tagging*" (B12), "*Using storage media (eg. USB flash drive) for storing information*" (B13), "*Recording information found online*" (B14) and "*Writing codes to automate execution of a task"* (B15) than undergraduates. The effect size for the statements is small effect.

Table 4.11: Rejected Null Hypothesis for Perception Towards Data Processing Skill ought to be Taught and Comparison between Undergraduates and Graduates.

Rejected Null Hypothesis	Mean Rank	Effect Size	Asymp. Sig.
"I agree that distinguishing potential information resources shall be taught in my higher education institution" are the same between			
Undergraduate	272.23		
Graduate	300.10	0.09	0.039
"I agree that evaluating information obtained from different sources shall be taught in my higher education institution" are the same between			
Undergraduate	271.35		
Graduate	301.86	0.10	0.023
"I agree that distinguishing official sites and personal sites shall be taught in my higher education institution" are the same between			
Undergraduate	268.04		
Graduate	308.49	0.12	0.003

Table 4.11 (Continued)

"I agree that organising digital information found through folders, bookmarks, tagging shall be taught in my higher education institution" are the same between			
Undergraduate	266.47		
Graduate	311.65	0.14	0.001
"I agree that using storage media (e.g. USB flash drive) for storing information shall be taught in my higher education institution" are the same between			
Undergraduate	268.57		
Graduate	307.43	0.12	0.006
"I agree that recording information found online shall be taught in my higher education institution" are the same between			
Undergraduate	264.16		
Graduate	316.28	0.16	0.000
"I agree that writing codes to automate execution of a task shall be taught in my higher education institution" are the same between			
Undergraduate	267.39		
Graduate	309.79	0.13	0.002

(e) Perception Towards Data Processing Skill ought to be Taught by Quantity Surveying Undergraduates and Graduates from UTAR

The p-value for all Data Processing skill statements is more than 0.05, therefore, it is failed to reject that QS undergraduates and graduates from UTAR are having the same perception towards Data Processing skill ought to be taught.

4.4.3 Mean Rank Differences Between Data Analysis Skill Acquired and Perception Towards Data Analysis Skill ought to be Taught

(a) Overall Comparison

The Wilcoxon Signed Rank Test result in Table 4.12 revealed that all Data Analysis skill statements were statistically significant at 95 % confidence level. The differences indicated that the perception of quantity surveying students and graduates towards Data Analysis skill ought to be taught were significantly higher than the Data Analysis skill acquired especially in "*Analysing data using*

software" (A16, B16), "*Knowing how data are used to make decisions*" (A17, B17), "*Interpreting data analysed*" (A18, B18), *"Compiling various information*" (A19, B19) and "*Rewriting compiled information with own language*" (A20, B20). The effect size for Data Analysis skill statements is having medium to large effect.

Table 4.12: Comparison between Self-assess Data Analysis Skill and Perception Towards Data Analysis Skill ought to be Taught.

Self-assess Data Analysis Skill	Mean Rank	Perception Towards Data Analysis Skill ought to be Taught	Mean Rank	z-value	Effect Size	Asymp. Sig
A16	141.84	B16	220.37	-16.380	0.49	0.000
A17	147.98	B17	203.73	-14.677	0.44	0.000
A18	176.83	B18	203.85	-15.088	0.45	0.000
A19	168.82	B19	184.75	-9.622	0.29	0.000
A20	166.09	B20	185.16	-9.417	0.28	0.000

Note: Refer to Table 3.4 for detail description of the skill acquired and skill ought to be taught.

(b) Data Analysis Skill Acquired by Undergraduates and Graduates

The results of Mann-Whitney Test in Table 4.13 revealed that at 95 % confidence level, graduates are statistically more competent than undergraduates in Data Analysis skill, especially in "*Analysing data using software*" (A16), "*Interpreting data analysed*" (A18), "*Compiling various information*" (A19) and "*Rewriting compiled information with own language*" (A20). Besides that, the statistically significant statements are having small effect size.

Table 4.13: Rejected Null Hypothesis for Data Analysis Skill Acquired and Comparison between Undergraduates and Graduates.

Rejected Null Hypothesis	Mean Rank	Effect Size	Asymp. Sig.
"I can analyse data using software" are the same between			
Undergraduate	272.17		
Graduate	300.21	0.08	0.046
"I can interpret data analysed" are the same between			
Undergraduate	271.59		
Graduate	301.37	0.09	0.030
"I can compile various information" are the same between			
Undergraduate	271.02		
Graduate	302.52	0.10	0.020
"I can rewrite compiled information with own language" are the same between			
Undergraduate	271.16		
Graduate	302.23	0.10	0.024

(c) Data Analysis Skill Acquired by Quantity Surveying Undergraduates and Graduates from UTAR

Table 4.14 showed the results of Mann-Whitney U Test which UTAR's QS graduates are statistically more competent in "*Analysing data using software*" (A16), "*Knowing how data are used to make decisions*" (A17) and "*Interpreting data analysed*" (A18) than UTAR's QS undergraduates. The three statements are having small effect size.

Table 4.14: Comparison of Data Analysis Skill Acquired by UTAR's QS Undergraduates and Graduates.

Rejected Null Hypothesis	Mean Rank	Effect Size	Asymp. Sig.
"I can analyse data using software" are the same between			
UTAR Undergraduate	107.69		
UTAR Graduate	139.73	0.18	0.009
"I know how data are used to make decisions" are the same between			
UTAR Undergraduate	107.52		
UTAR Graduate	140.85	0.19	0.006

Table 4.14 (Continued)

"I can interpret data analysed" are the same between			
UTAR Undergraduate	108.55		
UTAR Graduate	134.18	0.14	0.031

(d) Comparison between Perception of Undergraduates and Graduates Towards Data Analysis Skill ought to be Taught

Results of Mann-Whitney U Test in Table 4.15 disclosed that at 95% confidence level, graduates are statistically having higher agreement towards Data Analysis skill ought to be taught especially in "*Analysing data using software*" (B16), "*Knowing how data are used to make decisions*" (B17), "*Interpreting data analysed*" (B18), *"Compiling various information*" (B19) and "*Rewriting compiled information with own language*" (B20) than undergraduates. The effect size for the statements is small effect.

Table 4.15: Rejected Null Hypothesis for Perception Towards Data Analysis Skill ought to be Taught and Comparison between Undergraduates and Graduates.

Rejected Null Hypothesis	Mean Rank	Effect Size	Asymp. Sig.
"I agree that analysing data using software shall be taught in my higher education institution" are the same between			
Undergraduate	268.75		
Graduate	307.06	0.12	0.004
"I agree that knowing how data are used to make decisions shall be taught in my higher education institution" are the same between			
Undergraduate	267.37		
Graduate	309.83	0.13	0.002
"I agree that interpreting data analysed shall be taught in my higher education institution" are the same between			
Undergraduate	268.73		
Graduate	307.11	0.12	0.004

Table 4.15 (Continued)

"I agree that compiling various information shall be taught in my higher education institution" are the same between			
Undergraduate	266.43		
Graduate	311.73	0.14	0.001
"I agree that rewriting compiled information with own language shall be taught in my higher education institution" are the same between			
Undergraduate	268.62		
Graduate	307.34	0.12	0.005

(e) Perception Towards Data Analysis Skill ought to be Taught by Quantity Surveying Undergraduates and Graduates from UTAR

The p-value for all Data Analysis skill statements is more than 0.05, therefore, it is failed to reject that QS undergraduates and graduates from UTAR are having the same perception towards Data Analysis skill ought to be taught.

4.4.4 Mean Rank Difference Between Data Ethic Skills Acquired and Perception Towards Data Ethics Skill ought to be Taught

(a) Overall Comparison

The Wilcoxon Signed Rank Test result in Table 4.16 revealed that all Data Ethics statements were statistically significant at 95% confidence level. The differences indicated that the perception of quantity surveying students and graduates towards Data Ethics skill ought to be taught were significantly higher than the Data Ethics skill acquired especially in "*Acknowledging information found online*" (A21, B21), "*Establishing what online information can be legally reused*" (A22, B22), "*Asking permission before publishing other's content*" (A23, B23) and "*Familiar with Personal Data Protection Act 2010*" (A24, B24). The effect size for Data Ethics skill statements is having medium to large effect.

Table 4.16: Comparison between Self-assess Data Ethics Skill and Perception Towards Data Ethics Skill ought to be Taught.

Self-assess Data Ethics Skill	Mean Rank	Perception Towards Data Ethics Skill ought to be Taught	Mean Rank	z-value	Effect Size	Asymp. Sig
A21	150.69	B21	171.94	-8.871	0.26	0.000
A22	145.50	B22	192.56	-12.527	0.37	0.000
A23	138.57	B23	213.10	-14.182	0.42	0.000
A24	139.09	B24	228.15	-16.705	0.50	0.000

Note: Refer to Table 3.5 for detail description of the skill acquired and skill ought to be taught.

(b) Data Ethics Skill Acquired by Undergraduates and Graduates

The results of Mann-Whitney Test in Table 4.17 revealed that at 95% confidence level, graduates are statistically more competent than undergraduates in Data Ethics skill, especially in "*Acknowledging information found online*" (A21), "*Asking permission before publishing other's content*" (A23) and "*Familiar with Personal Data Protection Act 2010*" (A24). The statements are having small effect size.

Table 4.17: Rejected Null Hypothesis for Data Ethics Skill Acquired and Comparison between Undergraduates and Graduates.

Rejected Null Hypothesis	Mean Rank	Effect Size	Asymp. Sig.
"I can acknowledge information found online" are the same between			
Undergraduate	270.98		
Graduate	302.60	0.10	0.020
"I can ask permission before publishing other's content" are the same between			
Undergraduate	265.85		
Graduate	312.89	0.14	0.001
"I am familiar with Personal Data Protection Act 2010" are the same between			
Undergraduate	269.23		
Graduate	306.10	0.11	0.009

(c) Data Ethics Skill Acquired by Quantity Surveying Undergraduates and Graduates from UTAR

The results of Mann-Whitney Test in Table 4.18 revealed that UTAR graduates are statistically more competent than UTAR undergraduates in Data Ethics skill, especially in "*Asking permission before publishing other's content*" (A23) and "*Familiar with Personal Data Protection Act 2010*" (A24). The statements are having small effect size.

Table 4.18: Rejected Null Hypothesis for Data Ethics Skill Acquired and Comparison between Undergraduates and Graduates.

Rejected Null Hypothesis	Mean Rank	Effect Size	Asymp. Sig.
"I can ask permission before publishing other's content" are the same between			
UTAR Undergraduate	108.28		
UTAR Graduate	135.93	0.15	0.024
"I am familiar with Personal Data Protection Act 2010" are the same between			
UTAR Undergraduate	108.39		
UTAR Graduate	135.22	0.15	0.028

(d) Comparison between Perception of Undergraduates and Graduates Towards Data Ethics Skill ought to be Taught

Results of Mann-Whitney U Test in Table 4.19 disclosed that graduates are statistically having higher agreement towards Data Ethics skill ought to be taught especially in "*Acknowledging information found online*" (B21), "*Asking permission before publishing other's content*" (B23) and "*Familiar with Personal Data Protection Act 2010*" (B24) than undergraduates. The statements are having small effect size.

Table 4.19: Rejected Null Hypothesis for Perception Towards Data Ethics Skill ought to be Taught and Comparison between Undergraduates and Graduates.

Rejected Null Hypothesis	Mean Rank	Effect Size	Asymp. Sig.
"I agree that acknowledging information found online shall be taught in my higher education institution" are the same between			
Undergraduate	270.86		
Graduate	302.83	0.10	0.019
"I agree that asking permission before publishing other's content shall be taught in my higher education institution" are the same between			
Undergraduate	265.04		
Graduate	314.52	0.15	0.000
"I agree that familiar with Personal Data Protection Act 2010 shall be taught in my higher education institution" are the same between			
Undergraduate	265.88		
Graduate	312.82	0.14	0.001

(e) Perception Towards Data Ethics Skill ought to be Taught by Quantity Surveying Undergraduates and Graduates from UTAR

The p-value for all Data Ethics skill statements is more than 0.05, therefore, it can be concluded that fail to reject QS undergraduates and graduates from UTAR are having the same perception towards Data Ethics skill ought to be taught.

4.4.5 Mean Rank Difference Between Data Privacy Skill Acquired and Perception Towards Data Privacy Skill ought to be Taught

(a) Overall Comparison

The Wilcoxon Signed Rank Test result in Table 4.20 revealed that all Data Privacy statements were statistically significant at 95% confidence level. The differences indicated that the perception of quantity surveying students and graduates towards Data Privacy skill ought to be taught were significantly higher than the Data Privacy skill acquired especially in "*Refusing access to your geographical location*" (A25, B25), "*Identifying suspicious e-mail which trying to obtain your personal data*" (A26, B26), "*Checking security of website*

(e.g. https sites) which asking you to provide personal data" (A27, B27), "*Configuring settings in internet browser to limit cookies*" (A28, B28), "*Knowing how online personal data are collected*" (A29, B29) and "*Knowing how to protect privacy when conducting activities online*" (A30, B30). The effect size for Data Privacy skill statements is having medium effect.

Table 4.20: Comparison between Self-assess Data Privacy Skill and Perception Towards Data Privacy Skill ought to be Taught.

Self-assess Data Privacy Skill	Mean Rank	Perception Towards Data Privacy Skill ought to be Taught	Mean Rank	z-value	Effect Size	Asymp. Sig
A25	169.84	B25	203.42	-8.399	0.25	0.000
A26	151.14	B26	193.10	-9.541	0.28	0.000
A27	148.53	B27	195.47	-10.663	0.32	0.000
A28	176.51	B28	198.59	-10.103	0.30	0.000
A29	163.24	B29	197.71	-12.908	0.39	0.000
A30	159.55	B30	193.67	-12.774	0.38	0.000

Note: Refer to Table 3.6 for detail description of the skill acquired and skill ought to be taught.

(b) Data Privacy Skill Acquired by Undergraduates and Graduates

The results of Mann-Whitney Test in Table 4.21 revealed that at 95% confidence level, graduates are statistically more competent than undergraduates in Data Privacy skill, especially in "*Identifying suspicious e-mail which trying to obtain your personal data*" (A26), "*Configuring settings in internet browser to limit cookies*" (A28), "*Knowing how online personal data are collected*" (A29) and "*Knowing how to protect privacy when conducting activities online*" (A30).

Table 4.21: Rejected Null Hypothesis for Data Privacy Skill Acquired and Comparison between Undergraduates and Graduates.

Rejected Null Hypothesis	Mean Rank	Effect Size	Asymp. Sig.
"I can identify suspicious e-mail which trying to obtain your personal data" are the same between			
Undergraduate	270.45		
Graduate	303.65	0.10	0.018
"I can configure settings in internet browser to limit cookies" are the same between			
Undergraduate	270.01		
Graduate	304.54	0.10	0.013
"I know how online personal data are collected" are the same between			
Undergraduate	268.24		
Graduate	308.08	0.12	0.004
"I know how to protect privacy when conducting activities online" are the same between			
Undergraduate	269.36		
Graduate	305.84	0.11	0.009

(c) Data Privacy Skill Acquired by Quantity Surveying Undergraduates and Graduates from UTAR

The p-value for all Data Privacy skill statements is more than 0.05, therefore, it is failed to reject that QS undergraduates and graduates from UTAR are having the same competent in Data Privacy skill.

(d) Comparison between Perception of Undergraduates and Graduates Towards Data Privacy Skill ought to be Taught

Results of Mann-Whitney U Test in Table 4.22 disclosed that at 95% confidence level, graduates are statistically having higher agreement towards Data Privacy skill ought to be taught especially in "*Refusing assess to my geographical location*" (B25), "*Configuring settings in internet browser to limit cookies*" (B28) and "*Knowing how online personal data are collected*" (B29) than undergraduates.

Table 4.22: Rejected Null Hypothesis for Perception Towards Data Privacy Skill ought to be Taught and Comparison between Undergraduates and Graduates.

Rejected Null Hypothesis	Mean Rank	Effect Size	Asymp. Sig.
"I agree that refusing assess to geographical location shall be taught in my higher education institution" are the same between			
Undergraduate	272.37		
Graduate	299.81	0.08	0.048
"I agree that configuring settings in internet browser to limit cookies shall be taught in my higher education institution" are the same between			
Undergraduate	268.85		
Graduate	306.86	0.12	0.006
"I agree that knowing how online personal data are collected shall be taught in my higher education institution" are the same between			
Undergraduate	272.03		
Graduate	300.48	0.09	0.037

(e) Perception Towards Data Privacy Skill ought to be Taught by Quantity Surveying Undergraduates and Graduates from UTAR

The p-value for all Data Privacy skill statements is more than 0.05, therefore, it is failed to reject that QS undergraduates and graduates from UTAR are having the same perception towards Data Privacy skill ought to be taught.

4.5 Discussion

Section 2.6 reviewed the course curriculum of an accredited QS programme while Section 4.4 presented the findings of the questionnaire survey. This section discusses the result obtained from both Section 2.6 and Section 4.4 and compares towards the literature review in Chapter 2.

4.5.1 Overall Digital Skills Acquired and Perception Towards Digital Skills ought to be Taught

Based on the self-assessment of QS students and graduates, Data Collection skill is chosen as the most competent Digital Skill. In terms of Digital Skills ought

to be taught, Data Collection skill is ranked as the second Digital Skills which students and graduates perceived shall be taught in their higher education institution. Despite it is ranked as second among the five Digital Skills, Data Collection skill has the least difference in the mean between self-assess Data Collection skill and perception towards Data Collection Skill ought to be taught. QS students and graduates rated themselves as most competent in Data Collection skill may be due to the embedment of Data Collection skill in most of the courses of QS programme as shown in Section 2.6.

Data Processing skill has the second highest rank based on the self-assessment of students and graduates. At the same time, Data Processing skill has the second lowest rank in the perception towards Digital Skills ought to be taught. This has resulted in second lowest mean differences, and this may be also due to the inclusion of Data Processing skill in most of the courses of QS programme as per Section 2.6.

QS students and graduates assessed themselves as third competent in Data Analysis skill among the five Digital Skills. In spite of the middle rank in Digital Skill acquired, students and graduates perceived that Data Analysis skill as the most crucial Digital Skills which shall be taught in the QS programme by their higher education institution. This has resulted in the second highest mean differences. This may be due to insufficient Data Analysis skill covered in the course curriculum of QS programme.

Data Ethics skill is the Digital Skill which least competent among the students and graduates, but it is ranked as the third most important Digital Skills which ought to be taught by their higher education institution. Data Ethics skill has the highest mean differences showing that the teaching of Data Ethics skill in course curriculum of QS programme is still insufficient. As reviewed in Section 2.6, Data Ethics skill covered in the course curriculum is mostly focusing in acknowledging information found online.

Data Privacy skill is ranked as the second least competent Digital Skills by the students and graduates. At the same time, it is also ranked as the second least important Digital Skills that shall be taught in the QS programme by their higher education institution. The mean differences between the Data Privacy skill acquired and the perception towards Data Privacy skill to be Taught is the third highest among the five Digital Skills. This is also in accordance with the

discussion in Section 2.6 which there is minimal Data Privacy skill embedded in the course curriculum of QS programme.

4.5.2 Data Collection Skill

Among the five Data Collection skill statements, "*Designing data collection instruments online*" has the largest effect size. This shows that designing data collection online may not be sufficiently taught in QS programme as it is only covered in certain courses regarding research. Research by Martzoukou, et al. (2020) in Greece, Ireland and Scotland also found that students are more competent in finding information. On the other hand, "*Performing web search using web browsers relevant search engines (e.g. Google)*" has the smallest effect size, showing that it has been sufficiently covered in the course curriculum of QS programme which the differences between the skill acquired and perception towards the digital skill ought to be taught is small.

For Data Collection skill acquired by undergraduates and graduates, graduates are statistically competent than undergraduates in most of the Data Collection skill statements even though the statements are only showing small effect size. Graduates from UTAR are also statistically more competent than UTAR undergraduates in constructing strategies for searching information and using advanced features of search engine and having approximately medium effect size. This may indicate that those Data Collection skills can be slowly cultivated in the QS programme which at the end of the programme and with more working experience in the construction industry, they may be more competent in such skills.

In terms of perception towards Data Collection skill ought to be taught, graduates are still expressing higher agreement towards most of the Data Collection skill statements than undergraduates. This may be due to after working in the construction industry, graduates are having clearer picture of the importance of Data Collection skill than undergraduates who are still studying in the university.

4.5.3 Data Processing Skill

"*Writing codes to automate execution of a task*" shows the large effect among the ten Data Processing skill statements. It is clear that students and graduates

are aware of the importance of coding, but they are not acquiring sufficient coding skill in QS programme. This is corroborated by the research of Tan (2020) which construction players are only having fundamental awareness in coding skill. It is worthwhile to note that "*Using storage media (e.g. USB flash drive) for storing information*" is the only statement in Data Processing skill which students and graduates are having the perception that they are competent in using storage media and this skill does not have to be taught in the course curriculum of QS programme.

In terms of Data Processing skill acquired by undergraduates and graduates, it is discovered that graduates are statistically more competent than undergraduates in most of the Data Processing skill statements despite the statistically significant statements are having small effect size. Apart from that, UTAR QS graduates are also more competent than UTAR QS undergraduates in choosing trustworthy information and distinguishing between official and personal sites. This can also be seen in the similar research in Nigeria which approximately 60 % of the respondents are quite confident and very confident in assessing the trustworthy and credibility of the information (Adeoye and Adeoye, 2017). It may be inferred that further Data Processing skill can be learned by students after they join the construction industry.

Graduates are also having higher agreement towards most of the Data Processing skill statements ought to be taught in QS programme than undergraduates. This may imply that Data Processing skill is being applied in the working life of graduates, thus, they are expressing higher agreement towards the importance of Data Processing skill than undergraduates.

4.5.4 Data Analysis Skill

"*Analysing data using software*" is having large effect size and is statistically significant as proven by Wilcoxon Signed Rank Test. Students and graduates are perceiving that this skill is not adequately taught in QS programme. Apart from that, it can also be observed in research by Martzoukou, et al. (2020) which revealed that students are facing difficulties in analysing digital research data. Conversely, "*Rewriting compiled information with own language*" has obtained the smallest effect size. This shows that students and graduates are more

competent in this skill and perceive that this skill is less important to be taught in QS programme.

QS graduates are statistically competent than QS undergraduates in most of the Data Analysis statements although the statements are illustrating small effect. Graduates from UTAR are also statistically more competent than UTAR undergraduates in analysing data using software, knowing how data can be utilised for decision making and interpreting data analysis. The statistically significant statements are having small effect size. It is conjectured that students can learn more Data Analysis skill through gaining experience in working environment.

In terms of perception towards Data Analysis skill ought to be taught, graduates are still expressing higher agreement towards all Data Analysis skill statements than undergraduates. Having clearer picture on the demand of the construction industry, graduates may have higher agreement towards the importance of Data Analysis skill ought to be taught in higher education institutions.

4.5.5 Data Ethics Skill

Among the four Data Ethics skill statements, "*Familiar with Personal Data Protection Act 2010*" has the largest effect size. This implies that students and graduates are not familiar with legislation regarding data ethics and it is not sufficiently covered in the course curriculum of QS programme. In contrast, "*Acknowledging information found online*" has the smallest effect size. This shows that students and graduates are more competent in referencing and citing information being utilised. This can be seen in the coverage of referencing and citing in most QS courses. This is in contrast with the result of research by Martzoukou, et al. (2020) who discovered that students studying Library and Information Science are struggling in referencing the information utilised in an appropriate referencing style.

For Data Ethics Skill acquired by undergraduates and graduates, graduates are statistically competent than undergraduates in most of the Data Ethics skill statements in spite of the statements are only showing small effect size. Graduates from UTAR are also statistically more competent than UTAR undergraduates in asking permission before publishing other's content and

familiar with Personal Data Protection Act 2010. The two statements are having small effect size. This may infer that Data Ethics skill can be developed when students started working. In working environment, they will be upholding Data Ethics as per requirement by BQSM to recognise their ethical duties (Board of Quantity Surveyors Malaysia, 2020).

In terms of perception towards Data Ethics skill ought to be taught in higher education institutions, graduates are still expressing higher agreement towards most of the Data Ethics skill statements than undergraduates. This may be due to experienced gain in practising Data Ethics skill in their works.

4.5.6 Data Privacy Skill

"*Knowing how online personal data are collected*" is having the largest effect size among the six Data Privacy skill statements. students and graduates are perceiving that this skill is not adequately guided in QS programme. This can be seen in Section 4.2 which there are only few QS courses which embed Data Privacy skill in the QS courses. In contrast, "*Refusing access to your geographical location*" has the smallest effect size. This implies that students and graduates are more competent in protecting their location privacy and perceive that this skill is less important to be taught in QS programme.

QS graduates are statistically competent than QS undergraduates in most of the Data Privacy statements. The statistically significant statements are demonstrating small effect. It is conjectured that students will be more competent in protecting data privacy when they had more exposure to it.

For perception towards Data Privacy skill ought to be taught, graduates are expressing higher agreement towards some of the Data Analysis skill statements than undergraduates. Having knowledge on the importance of personal data, graduates may have higher agreement towards the importance of Data Privacy skill ought to be taught in higher education institutions.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the conclusions and recommendations based on the findings from Chapter Four. It discusses the three research objectives accomplished by showing the key findings of the research. The implications of the research to construction industry, accreditation bodies and academia are highlighted. Limitations of research is examined and followed by recommendations which can enhance the quality of future similar research.

5.2 Accomplishment on Research Aim and Objectives

Three research objectives set are accomplished to achieve the research aim and they key findings are summarised in the following sections.

5.2.1 Objective 1 – To Review Digital Skills Embedded in Course Curriculum of Quantity Surveying Undergraduate Programme in Malaysia

To accomplish this research objective, a course curriculum of an accredited quantity surveying programme is being reviewed. The quantity surveying course curriculum selected has been accredited by both local and abroad professional bodies which are BQSM and RICS. Through the review in Section 4.2, it is discovered that all five Digital Skill Sets are embedded in the course curriculum of quantity surveying programme. Data Collection skill, Data Processing skill and Data Ethics skill are embedded in most of the quantity surveying courses. However, some skills such as using advanced features of search engines and writing codes to automate execution of task are still less covered in quantity surveying courses. Data Ethics skill is applied in most of the QS courses, thus, QS students are familiar with acknowledging the information. Nevertheless, QS students are not familiar with asking for permission before publishing other's content such as reproducing figures created by others. Data

Privacy skill is less applied in QS courses and it is more towards the own application by QS students to protect their data.

5.2.2 Objective 2 – To Examine the Differences in the Digital Skill Set Acquired by Quantity Surveying Students and Graduates

This objective is accomplished through data analysis in Section 4.5. A question was set in the questionnaire which quantity surveying students and graduates are required to rate themselves in the 30 digital skills statements covering the five Digital Skill Sets. Based on the self-assessment, the result revealed that quantity surveying students and graduates are most competent in Data Collection skill while Data Ethics skill is the Digital Skill which they are least competent.

5.2.3 Objective 3 – To Assess Whether Quantity Surveying Undergraduates and Graduates Differ in Perception Towards Digital Skills Acquired and Ought to be Taught

This objective is accomplished by applying Wilcoxon Signed Rank Test which compared the Digital Skills acquired by quantity surveying undergraduates and graduates and their perceptions towards Digital Skills ought to be taught. All Digital Skills statements showed statistically increase in perception towards Digital Skills ought to be taught except using storage media for storing information. This implies that Digital Skills acquired by quantity surveying undergraduates and graduates are still insufficient as they are expressing agreement that those Digital Skills shall be taught in their higher education institution.

5.3 Research Implications

The implication of this research can be seen in three aspects which are construction industry, accreditation bodies and academia. First, this research contributes to the construction industry by providing a basic understanding of the Digital Skill required by quantity surveyors. Quantity surveyors may make use of the questionnaire of this research to assess their Digital Skills Acquired. For those statements in questionnaire which the quantity surveyors rated as

Fundamental Awareness, they may opt to further improve their Digital Skills either through the Continuing Professional Development programme which organised by professional bodies such as BQSM and RICS or through other online training service providers such as Malaysia Digital Economy Corporation.

Professional regulatory bodies such as BQSM and RICS may be benefited from the result of this research which they can update their accreditation manuals by including more specific requirements of Digital Skills in the course curriculum of QS programme. They may also publish guide notes to update their members on the latest status of Digital Skills acquired by quantity surveyors and forecast the future Digital Skills required.

In terms of academia, this research may act as fundamental research for academicians and HEPs as it reveals the digital skills acquired by quantity surveying students and graduates in Malaysia and their perceptions towards digital skills to be taught in the higher education institutions. HEPs may utilise the result of this research as a basis for revision of course curriculum to include more digital skills components in courses of QS programme.

5.4 Research Limitations

There are several limitations to this research. First, the course curriculum of QS programme analysed in this research is only limited to the course curriculum of UTAR QS programme. Although the UTAR QS programme is accredited by MQA, BQSM and RICS, its course curriculum may not be able to represent the QS programme of all higher education institutions in Malaysia.

Apart from that, although invitations had been sent to as many respondents as possible from different universities providing QS programmes in Malaysia, it is unable to obtain sample size of 30 and above for each university. Thus, the outcomes obtained may not be entirely generalisable to represent the QS programme in Malaysia.

The questionnaire survey was based on the self-assessment of the respondents. According to Martzoukou, et al. (2020), self-assessment may be less accurate measurement which the respondents may overestimate their ability. Some respondents may overrate their competences which also mean that digital

skill group with low values may require even more support than the actual outcome shown.

5.5 Research Recommendations

To overcome the limitations of this research, several recommendations are suggested to enhance future similar research. First, it would be worthwhile to continue with review of course curriculum of other higher education institutions providing QS undergraduate programmes in Malaysia. This will provide a clearer picture of the current status of Digital Skills embedded in the course curriculum of QS programme in Malaysia.

To solve the limitation of insufficient respondents from different universities providing QS programmes, it is recommended to request cooperation from the different universities to ensure the outcomes obtained are generalisable.

Self-assessment which may be less accurate measurement can be resolved by combining both self-assessment and quiz to increase the accuracy and reliability of the result.

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APPENDICES

APPENDIX A: Questionnaire

DIGITAL SKILLS AND COURSE CURRICULUM OF THE QUANTITY SURVEYING UNDERGRADUATE PROGRAMME IN MALAYSIA

Dear Sir/ Madam,

I am a final year undergraduate student currently pursuing Bachelor of Science (Honours) Quantity Surveying in Universiti Tunku Abdul Rahman (UTAR), Lee Kong Chian Faculty of Engineering and Science (LKC FES). You are invited to take part in a survey regarding "Digital Skills and Course Curriculum of the Quantity Surveying Undergraduate Programme in Malaysia". It would be appreciated if you could spare around 5 minutes to answer this questionnaire survey. Participation is voluntary and you may refuse to participate at any time. All the data collected will be kept private and confidential and will be strictly used for academic purposes only. If you have any questions or further enquiries, please do not hesitate to contact me at ycsim98@1utar.my. Thank you for your participation and have a nice day.

Thank you.

Yours faithfully,
Sim Yi Cheng
Bachelor of Science (Honours) Quantity Surveying
Universiti Tunku Abdul Rahman

Section A: Digital Skills Acquired by Quantity Surveying Students and Graduates

How do you rate yourself in the following competencies?

	Fundamental Awareness (Basic knowledge)	Novice (Limited experience)	Intermediate (Practical application)	Advanced (Applied theory)	Expert (Recognised authority)
Performing web search using relevant search engines (e.g. Google)					
Constructing strategies (e.g. keywords) for searching information					
Using advanced features of search engine (e.g. find information with exact word or phase)					
Using media-capture devices (e.g. recording on video)					
Designing data collection instruments online					
Filtering large number of search results quickly					
Distinguishing potential information resources					
Evaluating information obtained from different sources					
Assessing the reliability of online resources					

Choosing trustworthy sources of information					
Distinguishing official sites and personal sites					
Organising digital information found through folders, bookmarks, tagging					
Using storage media (eg. USB flash drive) for storing information					
Recording information found online					
Writing codes to automate execution of a task					
Analysing data using software					
Knowing how data are used to make decisions					
Interpreting data analysed					
Compiling various information					
Rewriting compiled information with own language					
Acknowledging information found online					
Establishing what online information can be legally reused					
Asking permission before publishing other's content					
Familiar with Personal Data Protection Act 2010					

Refusing access to your geographical location					
Identifying suspicious e-mail which trying to obtain your personal data					
Checking security of website (e.g. https sites) which asking you to provide personal data					
Configuring settings in internet browser to limit cookies					
Knowing how online personal data are collected					
Knowing how to protect privacy when conducting activities online					

Section B: Quantity Surveying Students' and Graduates' Perception Towards Importance of Digital Skills

Do you agree that the following competencies should be taught by your higher education institution?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Performing web search using relevant search engines (e.g. Google)					
Constructing strategies (e.g. keywords) for searching information					
Using advanced features of search engine (e.g. find information with exact word or phase)					
Using media-capture devices (e.g. recording on video)					
Designing data collection instruments online					
Filtering large number of search results quickly					
Distinguishing potential information resources					
Evaluating information obtained from different sources					
Assessing the reliability of online resources					
Choosing trustworthy sources of information					
Distinguishing official sites and personal sites					

Organising digital information found through folders, bookmarks, tagging					
Using storage media (eg. USB flash drive) for storing information					
Recording information found online					
Writing codes to automate execution of a task					
Analysing data using software					
Knowing how data are used to make decisions					
Interpreting data analysed					
Compiling various information					
Rewriting compiled information with own language					
Acknowledging information found online					
Establishing what online information can be legally reused					
Asking permission before publishing other's content					
Familiar with Personal Data Protection Act 2010					
Refusing access to your geographical location					
Identifying suspicious e-mail which trying to obtain your personal data					

Checking security of website (e.g. https sites) which asking you to provide personal data					
Configuring settings in internet browser to limit cookies					
Knowing how online personal data are collected					
Knowing how to protect privacy when conducting activities online					

Section C: Demographic Information

C1 Academic Year

	Year 1
	Year 2
	Year 3
	Year 4
	Graduated

C2 Current University or University Graduated

	Universiti Tunku Abdul Rahman (UTAR)
	Universiti Teknologi Malaysia (UTM)
	Universiti Teknologi MARA (UiTM)
	Universiti Sains Malaysia (USM)
	Universiti Malaya (UM)
	Universiti Islam Antarabangsa Malaysia (UIAM)
	Taylor's University
	SEGi University
	IMPERIA College
	Infrastructure University Kuala Lumpur (IUKL)
	INTI International University
	Heriot Watt University Malaysia
	UCSI University Kuala Lumpur
	University College of Technology Sarawak (UCTS)
	University of Reading Malaysia
	Tunku Abdul Rahman University College (TARUC)
	Universiti Malaysia Sarawak (Unimas)
	Linton University College
	Others: _____

APPENDIX B: Analysis of Quantity Surveying Course Curriculum

Course Name	Course Classification	Digital Skill	Study Activities	Digital Skill Sets
English for Professional	Compulsory	Yes	Sourcing information of assignment topic by using web search	Data Collection
			Sourcing information of assignment topic by using keywords	Data Collection
			Sourcing information of assignment topic through search engine by using exact word	Data Collection
			Using Google Form to collect data for assignment topic	Data Collection
			Filtering information collected by using keywords	Data Processing
			Choosing information from Google Scholar and other trustworthy sites	Data Processing
			Assessing reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
			Protecting respondents' data collected during research	Data Ethics
			Ensuring no sensitive personal data being collected during research	Data Privacy
Introduction to French	Elective	No	Not Applicable	Not Applicable
Tamadun Islam dan Tamadun Asia	MPU	Yes	Sourcing information of assignment topic by using web search	Data Collection
			Sourcing information of assignment topic by using keywords	Data Collection
			Sourcing information of assignment topic through search engine by using exact word	Data Collection
			Using Google Form to collect data for assignment topic	Data Collection
			Filtering information collected by using keywords	Data Processing
			Choosing information from Google Scholar and other trustworthy sites	Data Processing
			Assessing reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing

			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
			Protecting respondents' data collected during research	Data Ethics
			Ensuring no sensitive personal data being collected during research	Data Privacy
Management Principles	Elective	Yes	Sourcing company information by using web search	Data Collection
			Sourcing information of management principles by browsing reference books	Data Collection
			Sourcing information by using keywords (e.g. brand's name)	Data Collection
			Sourcing information through search engine by using exact phrase	Data Collection
			Filtering information collected by using keywords (e.g. planning)	Data Processing
			Choosing information from Google Scholar and trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Organisation And Human Resource	Elective	Yes	Sourcing company information by using web search	Data Collection
			Sourcing information of human resources theory by browsing reference books	Data Collection
			Sourcing information by using keywords (e.g. brand's name)	Data Collection
			Sourcing information through search engine by using exact phrase	Data Collection
			Filtering information collected by using keywords (e.g. training method)	Data Processing
			Choosing information from Google Scholar and trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis

			Citing the information used by using relevant citation format	Data Ethics
Data Analysis for Business Intelligence	Elective	Yes	Extracting various data from multiple data sources	Data Collection
			Data cleaning using pivot and pivot table	Data Processing
			Data visualisation through dashboard	Data Processing
			Interpreting descriptive statistics using frequency table, charts and diagrams	Data Analysis
			Perform predictive analytics on selected business problem	Data Analysis
Building Material	Core	Yes	Sourcing information of building materials by using web search	Data Collection
			Sourcing information of building material by browsing reference books	Data Collection
			Sourcing information by using keywords (e.g. concrete)	Data Collection
			Sourcing information through search engine by using exact word (e.g. advantage)	Data Collection
			Filtering information collected by using keywords (e.g. advantage)	Data Processing
			Choosing information from Google Scholar and trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Construction Technology I	Core	Yes	Sourcing information of building components by using web search	Data Collection
			Sourcing information of building components by browsing reference books	Data Collection
			Sourcing information by using keywords (e.g. staircase)	Data Collection
			Sourcing information through search engine by using exact word (e.g. characteristics)	Data Collection
			Filtering information collected by using keywords (e.g. dog-leg staircase)	Data Processing
			Choosing information from Google Scholar and library databases	Data Processing
			Assessing the reliability of information collected	Data Processing

			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Technical Drawing & CADD	Core	No	Not Applicable	Not Applicable
Hubungan Etnik	MPU	Yes	Sourcing information by using web search	Data Collection
			Sourcing information by using keywords (e.g. kesepaduan sosial)	Data Collection
			Sourcing information through search engine by using exact phrase (e.g. kesepaduan sosial)	Data Collection
			Using Google Form to collect data for research topic	Data Collection
			Filtering information collected by using keywords (e.g. segregasi, akomodasi)	Data Processing
			Choosing information from Google Scholar and trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
			Protecting personal data collected during the research	Data Ethics
			Ensuring not sensitive personal data was collected during the research	Data Privacy
Construction Technology II	Core	Yes	Sourcing information of building systems by using web search	Data Collection
			Sourcing information of building systems by browsing reference books	Data Collection
			Sourcing information by using keywords (e.g. diaphragm wall)	Data Collection
			Sourcing information through search engine by using exact word (e.g. benefit)	Data Collection
			Collecting data through interview with industry practitioners	Data Collection

			Filtering information collected by using keywords (e.g. method)	Data Processing
			Choosing information from method statement obtained from interviewee	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
			Asking permission before submitting method statement for assignment purpose	Data Ethics
Building Services	Non-Core	Yes	Sourcing information of building services by using web search	Data Collection
			Sourcing information of building services by browsing reference books	Data Collection
			Sourcing information by using keywords (e.g. water supply system)	Data Collection
			Sourcing information through search engine by using exact phrase (e.g. cold water system)	Data Collection
			Filtering information collected by using keywords (e.g. direct system)	Data Processing
			Choosing information from Google Scholar, library databases and trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Site Surveying	Core	Yes	Sourcing information of site surveying by using web search	Data Collection
			Sourcing information of site surveying by browsing reference books	Data Collection
			Sourcing information by using keywords (e.g. levelling)	Data Collection
			Sourcing information through search engine by using exact word (e.g. benchmark)	Data Collection
			Filtering information collected by using keywords (e.g. backsight)	Data Processing

			Choosing information from Google Scholar and library databases	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Economics of the Construction Industry	Core	Yes	Sourcing information of economics by using web search	Data Collection
			Sourcing information of economics by browsing reference books	Data Collection
			Sourcing information by using keywords (e.g. market structure)	Data Collection
			Sourcing information through search engine by using exact phrase (e.g. monopolistic competition)	Data Collection
			Filtering information collected by using keywords (e.g. demand)	Data Processing
			Choosing information from Google Scholar, library databases and trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Measurement of Building Works I	Core	No	N/A	N/A
Art, Craft and Design	MPU	Yes	Sourcing information by using web search	Data Collection
			Sourcing information by using keywords (e.g. marketing)	Data Collection
			Sourcing information through search engine by using exact phrase (e.g. 4P)	Data Collection
			Filtering information collected by using keywords (e.g. product)	Data Processing
			Choosing information trustworthy sites	Data Processing

			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Sun Zi's Art of War and Business	Compulsory	Yes	Sourcing company information by using web search	Data Collection
			Sourcing information by using keywords (e.g. strategic analysis)	Data Collection
			Sourcing information through search engine by using exact word (e.g. strength)	Data Collection
			Filtering information collected by using keywords (e.g. profit margin)	Data Processing
			Choosing information from Google Scholar and trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Mechanical and Electrical Services	Non-Core	Yes	Sourcing marketing price of mechanical and electrical services by using web search	Data Collection
			Sourcing information of mechanical and electrical services by browsing reference books (e.g. purging)	Data Collection
			Sourcing information by using keywords (e.g. precaution)	Data Collection
			Sourcing information through search engine by using exact phrase (e.g. commissioning)	Data Collection
			Filtering information collected by using keywords (e.g. testing)	Data Processing
			Choosing information from Google Scholar, library databases and trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing

			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Construction Financial Practice	Core	Yes	Sourcing information of cash flow by using web search	Data Collection
			Sourcing information of cash flow by browsing reference books	Data Collection
			Sourcing information by using keywords (e.g. cash flow)	Data Collection
			Sourcing information through search engine by using exact word (e.g. importance)	Data Collection
			Collecting data through interview with industry practitioners	Data Collection
			Filtering information collected by using keywords (e.g. challenge)	Data Processing
			Choosing information from project cash flow obtained from interviewee	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
			Asking permission before submitting cash flow for assignment purpose	Data Ethics
Measurement of Building Works II	Core	No	Not Applicable	Not Applicable
Professional Practice & Procedure I	Core	Yes	Sourcing information of procurement method by using web search	Data Collection
			Sourcing information of procurement method by browsing reference books	Data Collection
			Sourcing information by using keywords (e.g. procurement method)	Data Collection
			Sourcing information through search engine by using exact phrase (e.g. traditional procurement)	Data Collection
			Filtering information collected by using keywords (e.g. benefits)	Data Processing

			Choosing information from Google Scholar, library databases and trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Introduction to Law and Malaysian Legal System	Compulsory	Yes	Sourcing information of common law by using web search	Data Collection
			Sourcing information of common law by browsing reference books	Data Collection
			Sourcing information by using keywords (e.g. Branches of government)	Data Collection
			Sourcing information through search engine by using exact phrase (e.g. Malaysia cabinet)	Data Collection
			Filtering information collected by using keywords (e.g. composition of cabinet)	Data Processing
			Choosing information from Google Scholar, library databases and trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Building Structural System	Core	Yes	Sourcing information of structural elements by using web search	Data Collection
			Sourcing information of structural elements by browsing reference books	Data Collection
			Sourcing information by using keywords (e.g. structural element)	Data Collection
			Sourcing information through search engine by using exact phrase (e.g. foundation)	Data Collection

			Filtering information collected by using keywords (e.g. reinforcement)	Data Processing
			Choosing information from Google Scholar, library databases and trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Quantitative Analysis and Operational Research	Core	Yes	Sourcing information of research topic by using web search	Data Collection
			Sourcing information of research topic by using keywords (e.g. accommodation)	Data Collection
			Sourcing information through search engine by using exact word (e.g. students' considerations)	Data Collection
			Using Google Form to collect data for research topic	Data Collection
			Filtering information collected by using keywords (e.g. price, safety, security)	Data Processing
			Choosing information from Google Scholar, library databases and trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Analysing data using software (e.g. SPSS)	Data Analysis
			Interpreting data analysed to reach conclusion	Data Analysis
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
			Protecting personal data collected during the research	Data Ethics
			Ensuring not sensitive personal data was collected during the research	Data Privacy

Measurement of Civil and Infrastructure Works	Core	No	Not Applicable	Not Applicable
Estimating	Core	Yes	Sourcing marketing price of labour, plant and material by using web search	Data Collection
			Sourcing information of labour output by browsing reference books	Data Collection
			Sourcing information by using keywords (e.g. material price)	Data Collection
			Sourcing information through search engine by using exact phrase (e.g. Portland cement price)	Data Collection
			Filtering information collected by using keywords (e.g. skilled barbender)	Data Processing
			Choosing information from trustworthy sites (e.g. myN3C portal)	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Computer Aided Quantity Surveying	Core	Yes	Sourcing marketing price of material by using web search	Data Collection
			Collecting quantities of elements through software calculation	Data Collection
			Choosing information from trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Quantification using BIM tools such as Autodesk Revit and Autodesk Naviswork	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Applied	Core	Yes	Sourcing information of IBS and GBI by using web search	Data Collection

Construction Technology and Maintenance			Sourcing information by using keywords (e.g. industrialised building system)	Data Collection
			Sourcing information through search engine by using exact phrase (e.g. floor slabs)	Data Collection
			Filtering information collected by using keywords (e.g. precast hollow core slab)	Data Processing
			Choosing information from Google Scholar, library databases and trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Measurement of Building Works III	Core	No	Not Applicable	Not Applicable
Construction Management	Core	Yes	Sourcing information of construction site management by using web search	Data Collection
			Sourcing information by using keywords (e.g. labour management)	Data Collection
			Sourcing information through search engine by using exact word (e.g. working hours and salaries)	Data Collection
			Collecting data through interview with industry practitioners	Data Collection
			Filtering information collected by using keywords (e.g. attendance)	Data Processing
			Choosing information from proposed site layout obtained from interviewee	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis

			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
			Asking permission before submitting proposed site layout for assignment purpose	Data Ethics
Construction Economics	Core	Yes	Sourcing unit rates by using web search	Data Collection
			Sourcing information by using keywords (e.g. cost estimate)	Data Collection
			Sourcing information through search engine by using exact word (e.g. parametric cost estimate)	Data Collection
			Choosing information from Google Scholar, library databases and trustworthy sites (e.g. JKR Ratol)	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Professional Practice & Procedure II	Core	Yes	Sourcing information by using web search	Data Collection
			Sourcing information by using keywords (e.g. professional ethics)	Data Collection
			Sourcing information through search engine by using exact word (e.g. ethical perception)	Data Collection
			Collecting data through interview with industry practitioners	Data Collection
			Filtering information collected by using keywords (e.g. negligence)	Data Processing
			Choosing information from possible negligence obtained from interviewee	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing

			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
			Asking permission before submitting interview content for assignment purpose	Data Ethics
Industrial Training	Industrial Training	Yes	Sourcing information from company email and server	Data Collection
			Filtering large number of files using keywords (e.g. project name)	Data Processing
			Organising information through folders and bookmarks	Data Processing
			Analysing cost data using Microsoft Excel	Data Analysis
			Compiling tender price received	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format when preparing industrial training report	Data Ethics
			Ensuring project information are not disclosed without permission of industrial training company	Data Ethics
			Ensuring not sensitive information are disclosed in industrial training report	Data Privacy
Construction Law	Core	Yes	Sourcing information of alternative dispute resolution by using web search	Data Collection
			Sourcing information of tort law by browsing reference books	Data Collection
			Sourcing information by using keywords (e.g. alternative dispute resolution)	Data Collection
			Sourcing information through search engine by using exact word (e.g. mediation)	Data Collection
			Filtering information collected by using keywords (e.g. private and confidential, speedy)	Data Processing
			Choosing information from Google Scholar, library databases and trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing

			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Project Management	Core	Yes	Sourcing information by using web search	Data Collection
			Sourcing information by using keywords (e.g. project manager)	Data Collection
			Sourcing information through search engine by using exact word (e.g. architect)	Data Collection
			Collecting data through interview with industry practitioners	Data Collection
			Filtering information collected by using keywords (e.g. attributes)	Data Processing
			Choosing information from proposed site layout obtained from interviewee	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
			Asking permission before submitting interview content for assignment purpose	Data Ethics
Current Construction Issue	Elective	Yes	Sourcing information of advanced construction technologies by using web search	Data Collection
			Sourcing information by using keywords (e.g. advanced construction technologies)	Data Collection
			Sourcing information through search engine by using exact word (e.g. big data)	Data Collection
			Filtering information collected by using keywords (e.g. application)	Data Processing
			Choosing information from Google Scholar, library databases and trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis

			Citing the information used by using relevant citation format	Data Ethics
International Construction	Elective	Yes	Sourcing information of international construction by using web search	Data Collection
			Sourcing information by using keywords	Data Collection
			Sourcing information through search engine by using exact word	Data Collection
			Filtering information collected by using keywords	Data Processing
			Choosing information from Google Scholar, library databases and trustworthy sites	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Digital Construction	Elective	Yes	Sourcing information for building which has to be produced	Data Collection
			Sourcing information for using keywords (e.g. digital technologies	Data Collection
			Sourcing information through search engine by using exact word (e.g. additive manufacturing)	Data Collection
			Filtering information collected by using keywords (e.g. improve, enhance)	Data Processing
			Choosing information from Google Scholar, library databases and trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Using Autodesk Navisworks to take-off quantity	Data Processing
			Compiling most appropriate information regarding assignment topic	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Integrated Project	Project	Yes	Sourcing current selling price of the property and construction cost	Data Collection
			Collecting material and labour prices	Data Collection
			Analysing land price, property selling price	Data Processing
			Choosing information from trustworthy sites (e.g. property guru, edgeprop)	Data Processing

			Using folders and file names to organise information collected	Data Processing
			Analysing market strategies of proposed site (e.g. product, price)	Data Analysis
			Analysing construction cost of proposed project	Data Analysis
			Interpreting data collected for market analysis	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Value Management	Core	Yes	Souring project bill of quantities and drawings for value management study	Data Collection
			Sourcing information of research topic by using web search	Data Collection
			Sourcing information of research topic by using keywords (e.g. value management, cost cutting)	Data Collection
			Sourcing information through search engine by using exact word (e.g. value management, cost cutting)	Data Collection
			Assessing the reliability of bill of quantities and drawings collected	Data Processing
			Choosing information from Google Scholar, library databases and trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Analyse rates in bill of quantities to identify item with high value index	Data Analysis
			Conducting functional analysis according to hierarchy of functions	Data Analysis
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
			Asking permission for using of bill of quantities and drawings from project owner	Data Ethics
Property Development	Core	Yes	Sourcing selling price of surrounding properties	Data Collection
			Collecting construction price	Data Collection
			Analysing property selling price	Data Processing

			Choosing information from trustworthy sites (e.g. property guru, EdgeProp)	Data Processing
			Using folders and file names to organise information collected	Data Processing
			Conducting risk analysis	Data Analysis
			Analyse existing and anticipated market demand	Data Analysis
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Professional Practice and Procedure III	Core	Yes	Sourcing information of alternative dispute resolutions by using web search	Data Collection
			Sourcing information by using keywords (e.g. arbitration)	Data Collection
			Sourcing information through search engine by using exact word (e.g. PAM 2018)	Data Collection
			Filtering information collected by using keywords (e.g. challenges)	Data Processing
			Choosing information from Google Scholar, library databases and trustworthy sites	Data Processing
			Assessing the reliability of information collected	Data Processing
			Using folders to organise information collected	Data Processing
			Compiling most appropriate information	Data Analysis
			Rewriting information compiled using own words	Data Analysis
			Citing the information used by using relevant citation format	Data Ethics
Project	Project	Yes	Sourcing information of research topic by using web search	Data Collection
			Sourcing information of research topic by using keywords (e.g. digital skills)	Data Collection
			Sourcing information through search engine by using exact word (e.g. digital skills)	Data Collection
			Using Google Form to collect data for research topic	Data Collection
			Filtering information collected by using keywords (e.g. BQSM, RICS, MQA)	Data Processing
			Choosing information from Google Scholar, library databases and trustworthy sites	Data Processing

	Assessing the reliability of information collected	Data Processing
	Using folders to organise information collected	Data Processing
	Analysing data using software (e.g. SPSS)	Data Analysis
	Interpreting data analysed to reach conclusion	Data Analysis
	Compiling most appropriate information	Data Analysis
	Rewriting information compiled using own words	Data Analysis
	Citing the information used by using relevant citation format	Data Ethics
	Protecting personal data collected during the research	Data Ethics
	Ensuring not sensitive personal data was collected during the research	Data Privacy