EXPLORING UNIVERSITY STUDENTS' READINESS FOR THE INDUSTRIAL REVOLUTION 4.0: A CONCEPTUALISED FRAMEWORK

POH JOE YEE

BACHELOR OF INTERNATIONAL BUSINESS (HONOURS)

UNIVERSITY TUNKU ABDUL RAHMAN

FACULTY OF ACCOUNTANCY AND MANAGEMENT DEPARTMENT OF INTERNATIONAL BUSINESS

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BY

POH JOE YEE

A final year project submitted in partial fulfillment of the requirement of the degree of

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MAY 2024

DECLARATION

I hereby declare that:

(1) This undergraduate FYP is the end result of my own work and that due acknowledgement has been given in the references to ALL sources of information be they printed, electronic, or personal.

(2) No portion of this FYP has been submitted in support of any application for any other degree or qualification of this or any other university, or other institutes of learning.

(3) Sole contribution has been made by me in completing the FYP.

(4) The word count of this research report is 10,590.

Name of student:	Student ID:	Signature:
Poh Joe Yee	2102401	

Date: 3rd May 2024

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I would like to take this occasion to offer my deep appreciation to various people who helped me along my research excursion.

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Finally, I like to express my gratitude to everyone who contributed to the success of my final year project, both directly and indirectly. I am grateful for their commitment, support, and advice, which made this endeavour possible.

DEDICATION

I would like to dedicate this Final Year Project to my supervisor, Dr. Jayamalathi a/p Jayabalan, who guided me along the trip. I would certainly like to thank my friends and family for their encouragement and assistance in finishing my Final Year Project. I couldn't have gotten this far without their unfailing support.

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AI	Artificial Intelligence
CC	Cloud Computing
DV	Dependent Variable
E&E	Electrical and Electronics
EQ	Emotional intelligence
GDP	Gross Domestic Product
H1	Hypothesis 1
H2	Hypothesis 2
H3	Hypothesis 3
HEIs	Higher Education Institutions
ICT	Information and Communication Technologies
IR4.0	Fourth Industrial Revolution
IoT	Internet of Things
IQ	Intelligence Quotient
IS	Interpersonal Skills
IV	Independent Variable
PS	Problem-solving Skills
SPSS	Statistical Package for Social Sciences Version 29
TS	Technical Skills
TVET	Technical and Vocational Education and Training
USR	University Students' Readiness for IR4.0

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PREFACE

This research is submitted in partial fulfilment of the requirement for the degree of Bachelor of International Business (Honours) at Universiti Tunku Abdul Rahman (UTAR). This research paper is conducted under the supervision of Dr. Jayamalathi a/p Jayabalan. The title of this research is "Exploring University Students' Readiness for the Industrial Revolution 4.0: A Conceptualized Framework".

Before beginning this study, I was wondering about my peers' preparation for contemporary technologies and if they will use the technologies in conjunction with skills and competences for academic or professional purposes in the future. As a result, the two considerations listed above encouraged me to conduct this research.

This research project aims to identify the significant factors that will influence university students' preparation for the Industrial Revolution 4.0. The elements consist of three independent variables: technical capabilities, problem-solving skills, and interpersonal skills. As technology improves, organizations are increasingly recognizing the importance of IR4.0 technologies and requiring new staff to be knowledgeable about them. Consequently, this research paper could assist the companies to determine the awareness and readiness of university student regarding the IR4.0 technologies.

ABSTRACT

The worldwide trend of embracing the Fourth Industrial Revolution is accelerating, however Malaysia has yet to extensively apply it. The purpose of this study is to look at the factors that influence Malaysian graduates' readiness for the Fourth Industrial Revolution. This research uses the Fourth Industrial Revolution and three independent variables: Technical Skills (TS), Problem-solving Skills (PS), and Interpersonal Skills (IS). This study collected pertinent data by a questionnaire. The questionnaire consisted of 25 questions, and 400 sets of replies were gathered. SPSS software was used to analyse the results. Of the three independent variables, TS, PS, and IS were shown to have a substantial effect on the graduate's preparation for the Fourth Industrial Revolution. This study covers research summary, literature review, methodology, data analysis, discussion, conclusion, and implications. The study's limitation is that it only examined cross-sectional data to determine the skills and competences required in the labour market for implementing the Fourth Industrial Revolution. Furthermore, the data does not cover all additional skills and competencies required in developing countries.

CHAPTER 1: RESEARCH OVERVIEW

1.0 Introduction

The chapter presents a five-part overview of the topic. It then discusses the study's historiography, objectives, research concerns, and prominence. Overall, this study sheds light on student preparation for the Fourth Industrial Revolution.

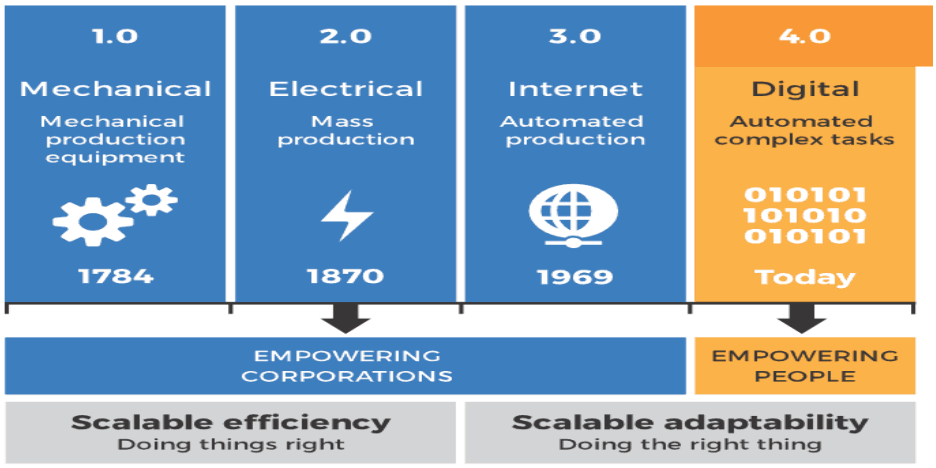
1.1 Research Background

1.1.1 Industrial Revolution 4.0 (IR4.0)

The term "industry 4.0," or "fourth industrial revolution," refers to a collection of sophisticated information technologies that swiftly address the particular requirements that vary in human characteristics (Javaid et al., 2020). It incorporates emerging digital technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), Big Data, Cloud Computing (CC), and 3D printing (Krishnan, 2021). By enhancing automation in the industrial and service industries, the technologies enable medical stakeholders to communicate and make decisions with reduced need for human intervention (Javaid et al., 2020). Modern technology additionally delivers precise updates on the number of attendees, which improves the sector's general efficacy and efficiency.

The plot presents the advent of automation and the production of mechanical power, particularly in the textile sector, and Industrial Revolution 1.0 got underway in the early 17th century. The primary objective was to increase production and quality of life using machine tools, steam power, and hydroelectric power. With the advent of steel and electricity to industries in the early 20th century, productivity increased, and machinery became more mobile, ushering in the Industrial Revolution 2.0. With the advent of automation and digitalization of microelectronics in 1969, the Industrial Revolution 3.0 made it possible for programmable machines to produce goods flexibly. Still, there is inadequate flexibility concerning output volumes (Davies, 2015).

Figure 1.1: The Stages of Industrial Revolution 4.0



Adapted from: Olivier, V. D. (n.d.), "The Industrial Revolution 4.0." *The Dualarity*.

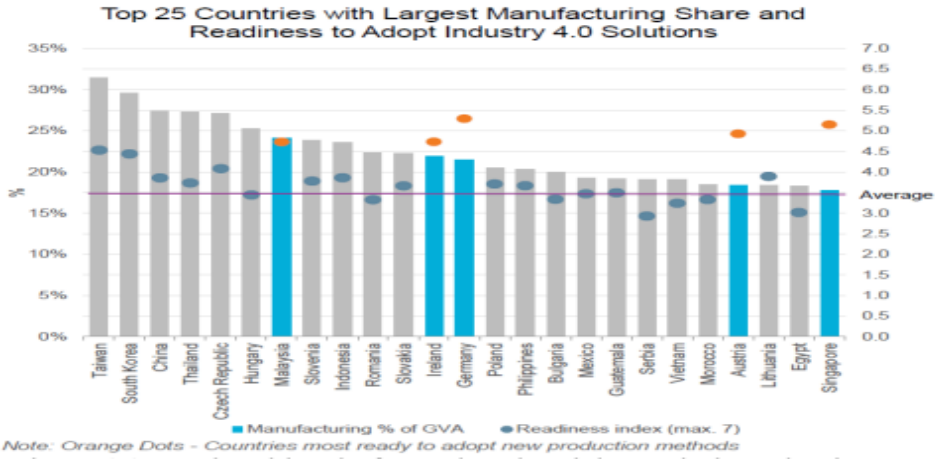
IR4.0, in contrast to the third industrial revolution, is a digital revolution that integrates cyber-physical systems, automation, closed-loop data models, and smart product customization. It transforms from a central industrial control system into a smart product that shows the stages in the production process. Developing nations may embrace this change by implementing blockchain, AI, and big data analytics to stay competitive and outpace their developing counterparts. Through this digitally driven industrial revolution, governments are shifting to be a part of a smart

society that enhances social and economic inclusion (Manda & Dhaou, 2019).

Malaysia is embracing the IR4.0 era, focusing on digitalization and new communication channels in all industrial sectors. The government is providing financial support through the Industry4WRD Intervention Fund to help small and medium-sized firms transition to IR4.0 technology, increasing productivity and growth ("Malaysia Accelerates Tech," 2023). The Industry4WRD Readiness Assessment helps businesses identify efficiency gaps and opportunities (Moreira, 2019). The Malaysian government established the Centre for the Fourth Industrial Revolution (C4IR) in Southeast Asia to promote digital-driven, high-income nation status and develop a regional digital economy aligned with IR4.0 trends that prioritize technology, process, and human factors for industrial improvements ("PM Launches Malaysia's," 2023). By 2025, Malaysia aims to boost manufacturing productivity and improve its global innovation ranking, demonstrating a strong commitment to leveraging IR4.0 for economic and industrial progress.

1.1.2 IR4.0 Adoption in Asian-Pacific Regional Level

Figure 1.2: Regional level of Fourth Industrial Revolution adoption



Adapted from: Dmitri, K. (2018, September 10). *New Principles and Business Models In The Era Of Industry 4.0*.

IR4.0, a digital revolution integrating the industrial internet across businesses, is increasingly being adopted by advanced nations in the Asia-Pacific region. China, a primary investor in venture capital, is focusing on manufacturing sector breakthroughs, utilizing technologies like AI, big data, and cloud computing. SANY Group and Huawei have created digital networks, while Tianjin Port Group established the world's first zero-carbon port terminal (Wu, 2023). China's commitment to IR4.0 skills is evident in its advanced manufacturing facilities, surpassing those in the EU, US, and Japan. China maintains a competitive edge in the global market by strategically focusing on advanced technologies like artificial intelligence and quantum information (Yeung, 2021).

Japan is implementing Industry 4.0 by integrating modern technologies like artificial intelligence, IoT, and big data analytics into its industrial sector. This aims to enhance productivity, reduce waste, and create tailored products. Companies like Mitsubishi Electric and Hitachi are leading the way, investing heavily in these technologies (Yeung, 2021). Thus, Singapore-based Moneythor has opened a Tokyo office, specializing in digital banking services like Apple Pay and Wallet Mobile (Andreasyan, 2020). Japan also adopts sustainable manufacturing methods and digital twins to improve efficiency and adapt to market demands.

By creating the Guangdong-Hong Kong-Macau Greater Bay Area (GBA) in Southern China, Hong Kong is embracing IR4.0. The government supports the local manufacturing sector with resources and technical assistance, including a 1.1m square foot facility for scalable production and prototyping, through the Hong Kong Science and Technology Parks Corporation (HKSTP) ("Hong Kong's Manufacturing," 2019). Also, the fast expansion of over 600 fintech businesses has been founded in Hong Kong. These businesses provide fintech solutions in several areas, such as

wealth tech, blockchain, insurance, RegTech, payment tech, and algorithmic trading ("InvestHK To Hold," 2020).

Singapore is aiming to integrate Industry 4.0 (IR4.0) into its manufacturing sectors, particularly on Jurong Island, with the Manufacturing 2030 goal of 50% growth by 2030. The Singapore Smart Industry Readiness Index (SIRI) provides a framework for companies to start, expand, and sustain digital transformation journeys using technologies like IoT, robots, and artificial intelligence ("Enabling Industry 4.0," 2023). With new technologies being tested and polished, Jurong Island is developing into a hub for innovative manufacturing, with the Jurong Innovation District leading the way ("6 New Technologies," 2021). Fintech startups like CoinPip, Fastacash, and Toast Me have pioneered digital money transfers, social payment platforms, and loan structure reform ("Top 30 Fintech," 2019).

Australia is putting IR4.0 into practice with a million-dollar testlab initiative, emphasizing robots, automation, IoT, cloud computing, algorithms, smart sensors, and sophisticated manufacturing processes ("Industry 4.0," 2020). Additionally, the initiative offers a physical location for collaboration between academic institutions and researchers. For improved communication and supply chain management, Australia is also utilizing operational software applications, including Enterprise Resource Planning (ERP), Project Lifecycle Management (PLM), Bill of Material (BOM), and Electronic Data Interchange (EDI) (Australian Industry Group, 2019).

With a priority on IR4.0 and the advancement of production technology via automation and data interchange, South Korea has adopted the Manufacturing Innovation 3.0 approach. It covers big data, IoT, 3D printing, cloud manufacturing, energy conservation, and smart sensors (Kim, 2019). Additionally, the Factory Energy Management System (FEMS) was introduced in South Korea. It consists of renewable energy monitoring systems, air compressor equipment, heat recovery ventilation,

and visualization of energy usage. Additionally, the nation has collaborated with a FinTech business for lending and investing operations, and it has implemented a countrywide 5G connection (Garikipati, 2019).

1.1.3 IR4.0 Adoption in Malaysia

According to the report of the International Trade Administration U.S. Department of Commerce (2022), Malaysia's ICT sector, accounting for 22.6% of GDP in 2021, has experienced rapid growth since the COVID-19 pandemic, significantly contributing to the country's Gross Domestic Product. Both public and commercial sectors are adopting digital transformation, with key industrial sectors' digitalization crucial for Malaysia's future global economy. This growth makes the ICT industry a vital part of IR4.0 development (Perakovic, Perisa & Zoric, 2019). According to the Malaysian National ICT Association, in line with the sector's expansion, the average salary growth rate in the ICT sector rose by 3.8% in 2019. On the other hand, as competent workers are scarce in the market, salaries have grown slowly ("PIKOM ICT job market outlook in Malaysia 2019," 2019).

1.2 Research Problem

Malaysia aims to become a high-income economy and strengthen its value chain by increasing the number of skilled workers. The country is adopting IR4.0 and related technologies, focusing on industries like electrical and electronics (E&E), which are predicted to significantly improve the country's GDP and export earnings. By 2025, the E&E business is expected to contribute RM120 billion to GDP and produce RM495 billion in export revenue. This expansion is part of the 12th Malaysia Plan, which emphasizes the use of new technology to improve product sophistication and industrial productivity ("E&E Industry To," 2021; "Malaysia To Achieve," 2021). The government is also implementing digital initiatives like the MyDIGITAL plan and the National Fourth Industrial Revolution (4IR) Policy to accelerate digital transformation and industrial change. These programs involve technology upgrades, workforce development, and technical and vocational education and training (TVET) to prepare a workforce for emerging industries ("Future Forward Economy," n.d.).

Technological unemployment, caused by delayed development due to new technology adoption, is a significant issue affecting the 21st century job market, as technological advancements may replace or create new jobs (Lima et al., 2021). It leads to another challenge that IR4.0 faced before entering the market, the abundance of expertise. As per the past researcher Turkes et al. (2019), obstacles include a lack of knowledge, cultural awareness, digital skills training, and professionals advocating for new technology. Workers must possess machine operation skills while maintaining high robotics execution rates. The need for integrated skills, training, and development in workers because of poor technical skills has led to the advancement of new competencies to attract fresh talent and improve project organizations (Aripin, Zawawi & Ismail, 2019). Therefore, Malaysia allocates significant government funds to higher education, as workers are the most impacted by digital workplace shifts. To adapt, HEI must address the lack of soft skills that are critical for entrepreneurial success, which can lead to greater success and economic contributions (Ogunsola, 2023).

The IR4.0 is changing the face of education worldwide, making it imperative to comprehend how ready students are for this new era (Schwab, 2017). However, current research on practical readiness for IR4.0 is limited, particularly in real-world situations that address technical and non-technical abilities (Johnson & Brown, 2017). It is particularly evident in developing countries like Malaysia, where the study of university students' daily use of technical and non-technical skills and their perception of IR4.0 application is scarce, highlighting a significant gap in the existing literature (Hasan, Hermanto, Yayah, Riswanti & Ujang, 2021). By disseminating information to stakeholders in business, government and education, this study seeks to understand student readiness for IR4.0, enabling institute with a quality education system to satisfy the evolving demands of the IR4.0 (Lee, Hwang & Chen, 2022). It also aims to enhance educational policies in developing nations like Malaysia by offering practical insights into students' digital readiness, enabling university students to adapt and benefit from a digitally responsive educational environment.

1.3 Research Objectives

1.3.1 General Objectives

The purpose of the study is to ascertain how university students' technical, interpersonal, and problem-solving skills relate to and impact their preparedness for IR4.0.

1.3.2 Specific Objectives

The study aims to specifically accomplish the followings:

1. To investigate the relationship between technical skills and university students’ readiness for IR4.0.

2. To determine the relationship between problem-solving skills and university students' readiness for IR4.0.
3. To determine the relationship between interpersonal skills and university students' readiness for IR4.0.

1.4 Research Questions

The core of this research is to scrutinize the relationship between the skills contributing to university students' readiness for IR4.0. The research question that aligns with this thesis is listed below:

1. Do technical skills influence university students' readiness for IR4.0?
2. Do problem-solving skills influence university students' readiness for IR4.0?
3. Is there any relationship between interpersonal skills and university students' readiness for IR4.0?

1.5 Research Significance

This research investigates and evaluates the vital influence of technical skills, problem-solving skills, and interpersonal skills on IR4.0 preparation of university students. The study also revealed research gaps as well as a general lack of awareness and knowledge on the subject. In the past, most studies have focused on developed countries, and this study's findings enhance the overall planning of IR4.0-based research. Discussions and findings can be useful and valuable for market participants, including investors, managers, cabinet members, and more.

This thesis also documents several significant advancements in the subject of IR4.0 preparedness. Educators must comprehend the impact of IR4.0 technologies on university students, and instructors must possess the necessary knowledge to impart. It is to ensure that students are aware of and prepared for their future

careers, not to mention succeed in today's fast-paced world. Additionally, university students must be aware of the skills and competencies needed to comply with IR 4.0.

1.6 Conclusion

Sententiously, this chapter summarizes how prepared university students are for IR4.0, and it also lays out the intended objectives of the study in this part. Past research on input variables and outcome variables, coupled with a theoretical overview and the methodology used for this study, are presented in the next section.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

In Chapter 2, the researcher will look at the underlying theories connected to the variables of this study before reviewing earlier research on the dependent and independent variables, including students' readiness for IR4.0, technical skills, problem-solving skills, and interpersonal skills respectively. Subsequently, the researcher will provide a rational framework to discern the arrangement of the variables' relationships. After the link has finally been outlined, the researcher will construct the examination hypothesis.

2.1 Underlying Theories

2.1.1 Chapnick Readiness Model

The readiness model of Samantha Chapnick simplifies the acquisition of fundamental knowledge for answering questions. The e-learning readiness review is critical to institutional development in identifying areas that need attention before launching an e-learning program. It outlines the impact of ICT on a nation, environment, or higher education facility (Coopasami, 2014). It divides 66 elements into eight categories, allowing practitioners to evaluate the business's readiness in each stakeholder in a company, using a question-style approach. By providing answers to the following

questions, Chapnick (2000) established a methodology for determining an organization's e-learning status:

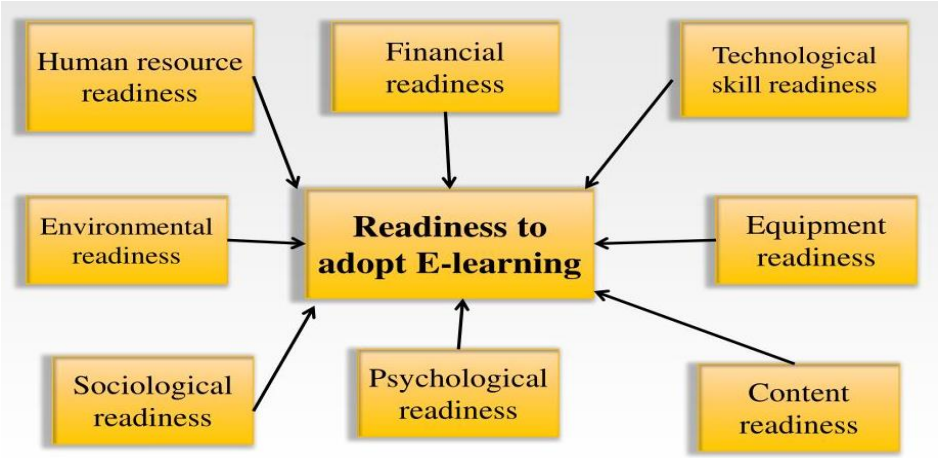
a) Can we accomplish this?

b) If we success, how can we do this?

c) What are the outcomes going to be, and how are we reviewing them?

The model categorizes variables into eight groups including psychological readiness, sociological preparedness, environmental preparedness, human resource preparedness, financial preparedness, technological competence preparedness, equipment readiness, and content readiness.

Figure 2.1: Dimensions of E-Learning Readiness



Adapted from: Chapnick, S. (2000). Are you ready for e-learning. *Learning Circuits: ASTD's Online Magazine All About ELearning*.

Psychological readiness is influenced by an individual's perspective on the e-Learning project's outcome. Sociological preparedness identifies the context of the program's implementation. Environmental preparedness considers the implications for stakeholders within and outside of a business. Human resource preparation indicates the accessibility and structure of the human support system. Financial preparation refers to the available financial assets. The term technological competence preparation refers to having access to technical help. Equipment readiness involves the

possession and accessibility of suitable equipment. Finally, content readiness focuses on the content generated for presentation in the curriculum. Thus, determining employability skills in IR4.0 requires consideration of psychological, environmental, financial, human resource, and technology preparedness (Halili, Fathima & Razak, 2022).

The Chapnick model offers managers various options for e-learning inquiries, with each option displayed with a point value. Managers add points for each segment and calculate the total score. The model suggests that companies with the lowest user classes are better prepared for e-learning. It helps managers identify areas for improvement and assess their company's readiness for e-learning (Marliani & Bandung, 2016).

2.2 Review of Variables

2.2.1 Students' Readiness for IR4.0

While the Merriam-Webster Dictionary (n.d.) defines readiness as the physical or psychological preparedness for an event or behavior, Hayes and Stratton (2013) restate the psychological notion of readiness refers to the sufficient preparation required for specific tasks to facilitate worthwhile learning. Additionally, according to Armenakis, Harris, and Mossholder (1993), it is defined as the mental antecedent to the behaviors of a change initiative in either opposition or endorsement (p. 682). Therefore, to enhance students' comprehension of IR4.0 and its applications, Higher education institutions (HEIs) must assess students' readiness before developing and conducting educational initiatives and training modules (Tinmaz and Jin, 2019). There is a growing body of material on students' preparation and preparedness for IR4.0 in higher education institutions in numerous countries, including South Africa, Malaysia, Thailand, South Korea, Brazil, and Italy.

Ujakpa, Osakwe, Iyawa, Hashiyana, and Mutalya (2020) discuss that Namibian students are aware of IR4.0 but need more instruction to function effectively. Most students are adept at utilizing IR4.0 initiatives without direct coaching. The study suggests that HEIs and government agencies should implement techniques to increase knowledge of IR4.0 and its applications. Then, Kayembe and Nel (2019) highlight the challenges faced by South Africa's education sector in implementing IR4.0, including educational adjustment, educator training, lack of financing and infrastructure, and equipping graduates with necessary technological skills.

A study by Inti International University and Colleges and International Data Corporation (IDC) in Malaysia found that students prioritize grades over developing necessary skills for success in the job market. The research revealed that parents, graduates, and students were not well-versed in IR4.0, raising questions about their readiness for a rapidly changing workforce. Over half of the students and graduates were unable to define IR4.0, indicating they felt unprepared (Rozana, 2019). Similarly, Ismail, Wan Hassan, Ahmad, Affan, and Harun's (2020) study at Malaysian Technical University maintains that despite 136 Bachelor of Vocational Education students' resilient preparedness and interest, their IR4.0 knowledge was lacking. In contrast, Ahmad, Segaran, Soon, Sapry, and Omar’s (2019) study on 200 undergraduate students at the University Tun Hussein Onn in Malaysia found that most were well-prepared for the IR4.0 period, using the necessary technical skills and adapting to new information. However, they acknowledged the need to develop leadership and communication skills for the IR4.0 era, particularly problem-solving in technology-related areas.

In addition, Puriwat and Tripopsakul (2021) assess that 132 graduate students in Thailand lack the knowledge and digital abilities required for the IR4.0 era, indicating a demand for improvements in the educational system. Tinmaz and Jin (2019) observed that 129 undergraduate students from a private South Korean university were unsure of IR4.0's actual uses, limiting their comprehension and participation in related activities. Thus,

as per Motyl, Baronio, Uberti, Speranza, and Filippi (2017), who assessed 463 undergraduate students at three Italian universities for readiness, the need for an appropriate educational paradigm to process structured data was emphasized. One method employed by Dos Santos, Vianna Jr, and Le Roux (2018) uses the programming capabilities of chemical engineering students to show the successful incorporation of IR4.0 skills into Brazilian classrooms. Assignments integrating chemical engineering and programming knowledge to create computational tools were set to improve students' IR4.0 readiness.

In short, research indicates that students are aware of IR4.0 but skeptical about its real-world applications. They are eager to learn about IR4.0 but often lack opportunities in schools, making them unprepared for the IR4.0 workforce. To date, this problem has received scant attention in research literature. Hence, HEIs should focus on educating students for the IR4.0 workforce, considering factors like students' traits, organizational dimensions, and understanding of various IR4.0 technologies.

2.2.2 Technical Skills

Technical skills, also known as computer and internet expertise, are essential for service delivery activities and the adoption of specialized tools (Aasheim, Williams & Butler, 2009; Rasaki & Abioye, 2018). These skills can be found in a variety of areas including IT expertise, programming languages, database management, accounting management, financial management and operations (Farkas & Nagy, 2008; Stone, 2011). Ample evidence exists to support the view that technical skills are required for students to be ready for IR4.0.

In a recent study, Maisiri, Darwish, and Van Dyk (2019) divided the skills required in IR4.0 into technical and non-technical. Technology, programming, and digital competencies are technical skills, whereas non-

technical skills include cognitive, social, and personal talents. The Internet of Things, cyber security, cloud computing, and data analytics are examples of technological talents, whereas non-technical skills include lifelong learning, communication, and leadership. Consistent with the findings of Maisiri et al., Ahmad et al. (2019) also did a study in Malaysia that classified skills as technical or non-technical. Technical skills are digital capabilities, whereas non-technical skills include communication, leadership, and problem-solving abilities. In line with previous research, Hecklau, Galeitzke, Flachs, and Kohl (2016) outlined four major skill classifications, mainly technical, methodological, social, and personal skills.

Recent studies have indicated that technical skills and digital literacy are indispensable for students to be equipped for the IR4.0 era. Elayyan (2021) interprets that students in Oman require technical skills, while Puriwat and Tripopsakul (2021) critique graduate students in Thailand's lack of digital and information capabilities, learning and innovation skills, and adaptability. According to Sahu, Agrawal, and Kukreja (2021), students in India must have problem-solving, communication, interpersonal, lifelong learning, and technical skills to boost their employability. Therefore, institutions are wrestling with difficulty in recognizing and improving technical capabilities in response to the workforce market prompt shifts (Bennett, 2019; Pham & Jackson, 2020). Additionally, engineers must possess strong technical capabilities, yet companies also prioritize non-technical abilities. Creative thinking and decision-making abilities, as well as technical skills, are essential in the industrial sector. The availability of facilities and the standards of the education system are vital for qualified workforces in the industrial industry (Fernández-Miranda, Marcos, Peralta & Aguayo, 2017; Jelonek, Nitkiewicz & Koomsap, 2020).

Various studies have demonstrated that pupils must acquire skills and capabilities to be ready for IR4.0, including analytical thinking, decision-making, organizational capacity, emotional intelligence, technological competence, and sophisticated problem-solving abilities (Assante, Caforio,

Flamini & Romano, 2019; Rampasso et al., 2020). While most research examines technical skills in engineering commerce, existing reports fail to address the practical preparedness of technological skills by daily usage as well as from the perspective of undergraduates.

2.2.3 Problem-Solving Skills

Problem-solving is a critical talent individuals discover via focus and self-evaluation (Heppner, Baumgardner & Jackson, 1985). Individuals build their skills by analyzing and making decisions that are affected by personality and school (Arnold, 1992). Thus, individuals can thrive in any sector by finding solutions to unique challenges (Armağan, Sağır & Çelik, 2009). Much of the current literature on IR4.0 readiness pays particular attention to the skills required, including problem-solving, critical thinking, creativity, people management, emotional intelligence, decision-making, and negotiation, as per Kamaruzaman, Hamid, Mutalib, and Rasul (2019).

A study by Wechsler et al. (2018) emphasizes the importance of complex problem-solving, critical thinking, and creativity in students, suggesting professional training and appropriate assessment criteria for knowledge construction. Moreover, Yu and Zin (2023) prove that incorporating critical thinking-oriented activities and tools into the learning process can enhance students' ability to evaluate and solve complex situations more effectively. Westerdahl, Carlson, Wennick & Borglin (2020) explore teaching strategies and outcome evaluations for nursing students to enhance critical thinking skills, emphasizing the importance of focused educational techniques that not only convey information but also cultivate cognitive abilities in IR4.0-driven sectors.

Yet, there appear to be discrepancies between some of the reported observations. Rahmat, Mohd Adnan, and Mohtar's (2019) research reveals

that students prioritize emotional intelligence over problem-solving, critical thinking, and service orientation skills for IR4.0 readiness. Emotional intelligence had the highest overall mean, followed by decision-making, people management, creative thinking, and bargaining. Nevertheless, Tang and He's (2023) study examined a new perspective, highlighting the significance of emotional intelligence in enhancing students' problem-solving abilities and preparing them for IR4.0. Emotional intelligence training can enhance students' problem-solving abilities by improving emotion control and cognitive processes, thereby enhancing their learning motivation in academic and professional preparation in technology-driven environments.

The divergent viewpoints in education necessitate a more comprehensive understanding of skill prioritization and a personalized approach. It emphasizes the need for comprehensive skill development programs that cater to diverse student needs, emphasizing problem-solving, critical thinking, and other skills. This integration is crucial in creating a curriculum that prepares undergraduates for the challenges of IR4.0.

2.2.4 Interpersonal Skills

Interpersonal skills refer to the capacity to communicate effectively, irrespective of social or cultural background (Porta, n.d.). Such skills, including active listening and effective speaking, are essential for teamwork in both professional and casual contexts (*Interpersonal Skills*, 2011). Motivation, leadership, negotiation, presentation, relationship-building, and public speaking are all examples of skills. Communication skills are essential for student achievement in schools, communities, and businesses. Thus, communication abilities have an indirect impact on self-esteem, social support, and achievement, contributing to both direct and indirect aspects (Kusnadi, Abdulkarim & Komalasari, 2020).

While technical skills are prerequisites for entry-level positions, HEIs must develop skills and mindsets that artificial intelligence cannot replicate, such as empathy, communication, emotional intelligence, networking, persuasion, cultural adaptability, ethics, and confidence, to remain competitive in an ever-changing era. Communication and cooperation skills are essential components of human literacy, as most achievements in the future will be made by cooperative efforts rather than individual efforts (Jones, Pilot, van Eijl & Lappia, 2020). Emotional intelligence (EQ) is the key to effective collaboration, as teamwork involves reconciling competing opinions. Neumeier's research (as cited in Jones et al., 2020) claims that EQ talents are four times more significant in the workplace than IQ, emphasizing the importance of these skills in building a collaborative and productive work environment.

Borges, Vannuchi, Grosseman, and González (2017) studied the DocCom online module, customized for Brazilian nursing students, focusing on cooperation and communication skills. Similarly, Giroux and Moreau's (2022) study evaluate the use of social media in nursing education, highlighting its potential to enhance both formal and informal learning and its ability to enhance communication and collaboration among students. Likewise, evidence-based practice teaching techniques and research integration in nursing practice were outlined, highlighting interactive teaching tactics (Horntvedt, Nordsteien, Fermann & Severinsson, 2018). To further illustrate, cooperative web-based education offers cost savings, safety enhancement, and remote laboratory access. These assignments simulate real-world international challenges, preparing graduates for future expert situations via collaborative studying and the realistic utility of theoretical information, as per Caño et al. (2022). On the contrary, Arantes do Amaral and Lino dos Santos (2018) argue that despite positive outcomes, collaboration was challenging due to non-contributing team members.

In short, the review highlights the need for educational institutions to develop strategies that promote and imitate collaborative situations,

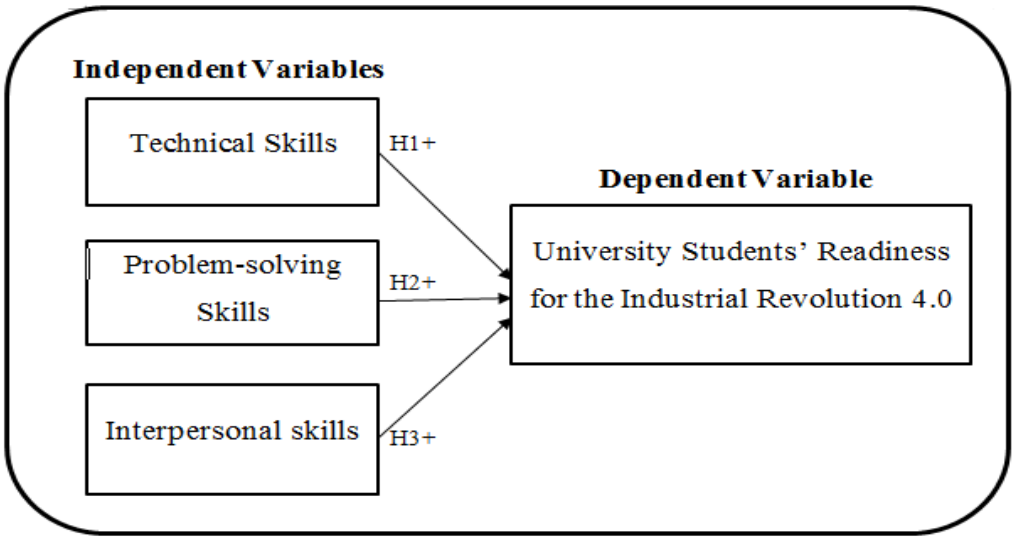
equipping students with essential interpersonal competencies for the complexity of future workplaces despite significant progress in incorporating interpersonal skills into educational frameworks.

2.3 Research Gap

The literature on students' preparation for the IR4.0 shows a significant research gap in understanding their practical preparedness, with less focus on their practical use of technical and non-technical abilities in everyday contexts and their perspectives on its implementation. Further, there is an evidence gap as relatively fewer studies have been carried out regarding university students' readiness for IR4.0 in developing nations such as Malaysia. Thus, there are methodological gaps where students' readiness measurements are not comprehensive and integrated. In essence, the gap necessitates improved programs and assessment of students' readiness for IR4.0 real-world applications, enabling the development of tailored educational strategies.

2.4 Conceptual Framework

Figure 2.2: Conceptual Framework



Source: Developed for the research.

Figure 2.2 shows proposed conceptual framework between technical skills, problem-solving skills, and interpersonal skills with university students' readiness for the Industrial Revolution 4.0.

2.5 Hypothesis Development

2.5.1 Technical Skills

Technical skills play a crucial role in determining student preparedness for IR4.0. Students with higher technical skills are better equipped to handle the demands of IR4.0, as they possess specialized abilities (Phua & Ho, 2021). Graduates with IR4.0 capabilities are in high demand, making them more competitive in the employment market (Abdullah, Humaidi & Shahrom, 2020). Therefore, this research hypothesizes that technical skills significantly influence university students' IR4.0 readiness, as they are essential for success in the rapidly evolving IR4.0 landscape.

H1: Technical skills positively influence university students' IR4.0 readiness.

2.5.2 Problem-Solving Skills

Problem-solving skills are essential for IR4.0 readiness, as they enable professionals to address complex, transdisciplinary challenges and adapt to new systems and methods (Sanjeev, 2023). As technology advances, rigorous data analysis and adaptability are essential in various business settings. Students with strong problem-solving skills are better fitted for IR4.0 demands, as they are valued as workplace assets and have a bright

future (Nurisyal, Norhaninah, Suzilawati & Syatila, 2019). Therefore, problem-solving skills dramatically affect university students' IR4.0 readiness.

H2: Problem-solving skills positively affect university students' IR4.0 readiness.

2.5.3 Interpersonal Skills

Interpersonal skills are significant for university students to prepare for IR4.0 expectations, which promote vertical integration through transparency, information exchange, and collaborative decision-making. These skills enable employees to collaborate with colleagues, consider opposing opinions, and influence work practices for the entire supply chain (Sony & Mekoth, 2022). A broad spectrum of knowledge is necessary for giving presentations and reporting to project teams, ensuring all team members comprehend the project's deliverables (Aminul, 2022). It becomes clearer that interpersonal skills have an important impact on university students' IR4.0 readiness.

H3: Interpersonal skills have a positive impact on university students' IR4.0 readiness.

2.6 Conclusion

In summary, Chapter 2 offers an outline of preceding research that verifies students' readiness for IR4.0. The findings display a hyperlink between students' preparation for IR4.0 and independent factors which includes technical skills, problem-solving skills, and interpersonal skills. This chapter additionally built a research framework and hypothesis to assist readers apprehend the point of

interest of this study. The following chapter will offer procedures and an empirical model for hypothesis testing.

CHAPTER 3: METHODOLOGY

3.0 Introduction

This chapter describes the research methods of this study, with a focus on developing research methods that meet academic standards. It explains the research design, sample design, research instrument, data collection methods, data processing, and analysis, emphasizing the importance of using the appropriate research method to ensure the validity of the findings.

3.1 Research Design

The research design logically integrates several aspects to accomplish the research problem. According to Creswell (2014), it is used in qualitative, quantitative, and mixed research methodologies to deliver tailored guidance for research study procedures. Siedlecki (2020) views descriptive research as a quantitative tool for studying a population's characteristics and identifying possible difficulties within a group, organization, or population. Furthermore, quantitative research serves the purpose of evaluating proposed theories and concepts by scrutinizing variable connections. It may be measured and quantified using instruments that yield numerical results (Basias & Pollalis, 2018; Sukamolson, 2007). This approach facilitates research structure and assesses data using standardized assessments (Carr, 1994).

This study combined descriptive and quantitative research to predict university students' preparation levels for IR4.0. Thus, data will be collected by distributing

questionnaires to participants to gain insight into their thoughts and subjective perceptions.

3.2 Sampling Design

Research design demands a sampling plan that considers the target population, sample characteristics, location, procedure, and sample size in the following step.

3.2.1 Target Population

A target population is a group directly related to the researcher's study topic that the researcher can collect, process, and derive conclusions based on information supplied by the target population (Draugalis, 2009). In this study, the target respondents are students who are currently pursuing higher-level education in Malaysia.

3.2.2 Sampling Element

The sampling element denotes the unit of analysis, which might be an individual, a group, an association, or an institution. Considering the purpose of this research is to investigate university students' preparation level for IR4.0, students presently pursuing higher-level education in Malaysia, including foundation, undergraduates, and postgraduate level, and are currently residing in Malaysia, regardless of nationality, constitute the sampling element for this study.

3.2.3 Sampling Frame and Sampling Location

The sampling frame, which specifies the number of samples to be selected from the entire target population, was not defined due to the large target population of this research.

Apart from that, a sampling location refers to the precise place or geographical area of conducting the research. The sample location for this study was in Malaysia. Hence, this survey has no restrictions on respondents' nationality since everyone who lives in Malaysia, regardless of state or area, may be considered the intended respondents of this study.

3.2.4 Sampling Technique

Probability sampling and non-probability sampling are the two categories of sampling techniques. Probability sampling ensures an equal chance of inclusion in the sample based on a random selection of population members, whereas non-probability sampling relies on the researcher's capacity to determine sample elements (Singh, 2018; Taherdoost, 2016).

As this study lacks a predetermined sample frame, non-probability convenience sampling is suitable for collecting data from massive populations. This technique facilitates researchers to prioritize readily available and recruitable individuals based on geographical location. Also, convenience sampling saves time and costs by eliminating the need to schedule in-person interviews (Taherdoost, 2016).

3.2.5 Sample Size

The number of target respondents chosen from the population in a research study is referred to as sample size (Etikan, Musa & Alkassim, 2016). A higher sample size results in a more accurate depiction of the true population mean. According to the Ministry of Higher Education (2022),

there are 20 public universities, 36 polytechnics, 105 community colleges, and over 404 private higher education institutions in Malaysia, for a total of 565 higher educational establishments. Thus, the reported number of students enrolled in HEIs across all levels of study for the year 2022 was 1,202,202. Therefore, Slovin's Formula, as presented below, is used to compute the study's sample size.

$$n = \frac{N}{1 + Ne^2}$$

Whereby, n = Sample size

N = Total population

e = Confidence level

The average confidence level ranges from 90% to 95%, whilst the 95% level offers more accuracy with an ideal margin of error of 0.05 (Singh & Masuku, 2014). Thus, this study's sample size was estimated as follows:

$$n = \frac{1{,}202{,}202}{1 + 1{,}202{,}202(0.05)^2}$$

$$n = \frac{1{,}202{,}202}{3{,}006.505}$$

$$n = 399.867$$

$$n \approx 400$$

Hence, by using Slovin's formula, the appropriate sample size for this research is 400.

3.3 Data Collection Methods

Data collection embraces obtaining, measuring, and interpreting statistics to answer research questions, test hypotheses, and develop conclusions, with primary and secondary sources as the principal data collection methods (Zikmun, Babin, Carr & Griffin, 2013).

3.3.1 Primary Data

Primary data, assembled first-hand through unpublished experiments, surveys, and interviews, is more credible and authentic since it is particular to the study topics (Driscoll, 2011; Kabir, 2016). This research project retrieves primary data by delivering questionnaires to respondents via Google Forms. The self-administered questionnaires have been altered from prior research publications to assure reliability.

3.3.2 Secondary Data

Secondary data, retrieved and reviewed by previous scholars, is gathered from published sources such as textbooks, biographies, and online databases, making data collecting more convenient and cost-effective (Bustamante-Gavino, Rattani & Khan, 2011; Kabir, 2016). This study will predominantly use secondary data from online journals, papers, and websites sourced from qualified platforms such as Google Scholar, UTAR library online database, Emerald Insights, Science Direct, Sage, ResearchGate, and SpringerLink for literature review purposes.

3.4 Preliminary works

Preliminary work involves examining previous techniques and procedures in a study. It involves assessing predictors and variables, creating surveys, selecting relevant publications with sample questionnaires, rephrasing questionnaires, and obtaining ethical clearance from the UTAR Scientific and Ethical Assessment Committee before sharing them with respondents. This critical step ensures the validity and reliability of the research.

3.5 Research Instrument

Research instruments are tools for gathering, assessing, and analyzing data pertinent to a study topic (Wilkinson & Birmingham, 2003).

3.5.1 Survey Questionnaire

This study employed a survey method to collect primary data on respondents' IR4.0 preparation levels. Wilkinson and Birmingham (2003) pointed out the cost-effectiveness of online data collection, compared to physical questionnaires, making it an accessible and efficient method for gathering targeted information.

3.5.2 Questionnaire Design

This study developed an English-language questionnaire to gather data on university students' readiness for the Industrial Revolution 4.0. The questionnaire was organized into three sections including the cover page, demographics, and the main body of questions. The cover page included the research topic, introduction, background, data protection notice, and a screening question intended to exclude non-higher education students. The

demographic component gathered data on respondents' demographic traits and IR4.0 comprehension levels, allowing researchers to gain a deeper understanding. The following segments employed a five-point Likert scale ranging from "strongly disagree" to "strongly agree" to measure all dimensions, including respondents' readiness for the IR4.0 and the factors that affected it.

Table 3.1: Total number of items included in each variable

Variables	**Construct**	**Number of Items**
	Filter Question	1
	Demographic Question	4
Independent Variable	Technical Skills	5
	Problem-Solving Skills	5
	Interpersonal Skills	5
Dependent Variable	Readiness for IR4.0	5

Source: Developed for the research.

3.5.3 Pilot Test

The survey questionnaire was distributed to 30 respondents to identify potential inaccuracies. Respondent feedback was used to correct flaws during dissemination. To address unfamiliarity with the term "Industrial Revolution 4.0," visual aids and short descriptions were added. Respondent data improved questionnaire quality by removing inaccuracies from the pilot test. The pilot test's internal reliability and validity were assessed using Cronbach's Alpha via SPSS, and the results are shown in Table 3.2.

Table 3.2: Pilot test results (N=30)

Variables	No. of Items	Cronbach's Alpha	Reliability Level
IR4.0 Readiness	5	0.898	Very Good Reliability
Technical Skills	5	0.785	Good Reliability
Problem-Solving Skills	5	0.808	Very Good Reliability
Interpersonal Skills	5	0.890	Very Good Reliability

Source: Developed for the research.

3.6 Construct Measurement

3.6.1 Measurement of Scale

Scale measurement is the approach used to identify and quantify variables. In this study, the researcher will administer the questionnaire survey using three scales, including nominal, ordinal, and Likert scales.

3.6.1.1 Nominal Scale

A nominal scale classifies and organizes components into categories with distinct labels or descriptors (Bhat, 2019; Zikmund, Babin, Carr & Griffin, 2013). In this research, the nominal scale was used to identify the respondents' demographic information, such as gender and education level.

Table 3.3 Example of Nominal Scale

What is your gender?

o Male	o Female

Source: Developed for the research.

3.6.1.2 Ordinal Scale

An ordinal scale is a metric that ranks and coordinates data, allowing for value allocation or variable comparison based on relative ordering, yet with unequal or unknown distances between categories or qualities (Salkind, 2010; Tastle & Wierman, 2006). Instantly, Question 2 in Section A of the survey employed an ordinal scale to assess participant age.

Table 3.4 Example of Ordinary Scale

What is your age group?
o 18-22 years old
o 23-27 years old
o 28-32 years old
o 32-37 years old
o 38 years old and above

Source: Developed for the research.

3.6.1.3 Likert Scale

A Likert scale is a five or seven-point scale used in surveys to indicate the extent to which respondents agree or disagree with a given statement (McLeod, 2019). It is widely employed when the data is straightforward to collect, with a score of 1 indicating strong disagreement and 5 representing strong agreement (Colosi, 2006; Awang, Afthanorhan & Mamat, 2015).

Thus, Likert scales were used in this study for responding to questions of dependent and independent variables.

Table 3.5 Example of Five-Point Likert Scale

No.	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	The availability of the electronic resources minimized the time I spent searching for information and knowledge.					

Source: Developed for the research.

3.6.2 Origin of Construct

The measuring of components in sections B and C of the questionnaire was modified from several previous types of literature researchers (refer to Appendix C).

3.7 Data Processing

Data processing entails collecting, screening, editing, coding, transcribing, and cleaning questionnaire data to guarantee legitimate and accessible responses while excluding or discarding those that violate the research's standards, thus yielding pertinent data for the study.

3.7.1 Data Checking

Data checking assures the accuracy and quality of surveys before using, importing, or processing the data. It seeks to identify inaccuracies and ensure that surveys are clear and intelligible. By closely examining and evaluating obtained data, it maintains the reliability and quality of the questionnaires, decreasing mistakes and eliminating them from the research.

3.7.2 Data Editing

According to the Statistics Centre (2017), data editing is the practice of verifying and altering survey data to guarantee its accuracy, consistency, and readability. It consists of two steps, including editing and rectifying any inaccuracies in surveys before analysing the acquired raw data.

3.7.3 Data Coding

Data coding is a procedure that derives a preliminary code from observable data to convey the core idea and significance of the information gathered from targeted respondents (Reading Craze, 2014). The researcher incorporates a value, percentage, or numerical code to each response to a question to facilitate the data transfer procedure to data analytics tools.

Consequently, it aids researchers in concluding data evaluation. For this study, the data obtained is coded as indicated in table 3.4 and table 3.5.

Table 3.6: Data Coding for Section A (Demographic Profile)

Question No.	**Label**	**Coding**
Q1	Education Level	1 = STPM/ A-level/ Foundation 2 = Diploma 3 = Bachelor's degree 4 = Master's degree 5 = Doctorate degree
Q2	Gender	1 = Male 2 = Female
Q3	Age	1 = 18-22 years old 2 = 23-27 years old 3 = 28-32 years old 4 = 33-37 years old 5 = 38 years old and above
Q4	Ethnicity	1 = Malay 2 = Chinese 3 = Indian 4 = Others

Q5	IR4.0 Knowledge Level	1 = Nothing 2 = Little 3 = Something 4 = A lot 5 = Proficient

Source: Developed for the research.

Table 3.7: Example of data coding for Section B, C

Question	Coding
The availability of the electronic resources minimized the time I spent searching for information and knowledge.	1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree

Source: Developed for the research.

3.7.4 Data Transcribing

Churcher (2017) highlights the vitality of data transcription in this study, which involves interpreting or translating audio or video recordings into text for analysis and coding. The encoded data from the questionnaire is then transformed from Microsoft Forms to Microsoft Excel before being sent to the Statistical Package for Social Sciences (SPSS) Version 29 for further processing and analysis.

3.7.5 Data Cleaning

Missing data and outliers are to be identified and removed in the data-cleaning procedure. The study used SPSS Version 29 software to detect and eliminate missing data and outliers, hence assuring data collection consistency. The action of removing extreme values is to prevent data distortion and misconceptions, while unreliable findings are identified to ensure consistency.

3.8 Proposed Data Analysis Tool

3.8.1 Data Analysis

Data analysis is the act of converting raw data into useful information that assists in making well-informed choices. To analyze and assess the acquired data, this study uses the Statistical Package for Social Science SPSS version 29 and Microsoft Excel.

3.8.2 Descriptive Analysis

Descriptive analysis is essential for evaluating and describing respondents' characteristics by giving descriptive statistics such as mode, mean, median, range, and variance, as well as measures of central tendency and variation (Lankford, 2002; Zikmund et al., 2013).

In this study, the researcher collects respondents' demographic personal information to identify common trends using the mean, mode, and median. With descriptive statistics used to analyze the findings, the data will then be displayed as tables or graphs, such as histograms and pie charts.

3.8.3 Reliability Analysis

This study will employ a reliability test to ensure that data is consistent and stable, with minimal errors. Cronbach's alpha is a regularly used method for determining internal consistency by calculating the average inter-item correlation and coefficient. Thus, the outcome presented was a number between 0 and 1. Ursachi, Horodnic, and Zait (2015) claimed that a reliability coefficient of 0.6-0.7 is adequate, while 0.8 or above is exceptionally excellent, and scores above 0.95 may indicate redundancy.

Figure 3.1 Rule of thumb of Cronbach's alpha

Cronbach's Alpha	Strength of Association
0.80- 0.95	Very Good Reliability
0.70 - 0.80	Good Reliability
0.60 - 0.70	Fair Reliability
Less than 0.60	Poor Reliability

Source: Leontitsis, A., & Pagge, J. (2007). A simulation approach on Cronbach's alpha statistical significance. *Mathematics and Computers in Simulation*, *73*(5), 336-340.

3.8.4 Inferential Analysis

3.8.4.1 Pearson Correlation Coefficient Analysis

Pearson correlation analysis assesses the strength of a linear relationship between independent and dependent variables using coefficients ranging from -1 to +1. Positive correlations imply the same direction of change, whereas negative correlations suggest the inverse direction of change (Turney, 2022). Moreover, the stronger the effect of the independent variable on the dependent variable, the closer the outcome is to the number

of 1. The table below provides a general rule for interpreting the Person Correlation Coefficient level.

Table 3.8: Rules of Thumb of Pearson Correlation Coefficient

Coefficient range	Strength of Association
±0.91 to ±1.00	Very High Positive/Negative Correlation
±0.71 to ±0.90	High Positive/Negative Correlation
±0.41 to ±0.70	Moderate Positive/Negative Correlation
±0.21 to ±0.40	Low Positive/Negative Correlation
0.00 to ±0.20	Negligible Correlation

Source: Hair, J. F., Money, A. H., Samouel, P., & Page, M. (2007). Research methods for business. *Education+ Training*, *49*(4), 336-337.

3.8.4.2 Multiple Linear Regression Analysis

Multiple regression analysis, an extension of simple regression analysis, explains the variance of DV with more than one IV (Petchko, 2018). In this study, Multiple Regression Analysis will be employed to illustrate the relationship along the significance of each IV in predicting the DV. The multiple regression analysis formula is as follows:

$$Y = b0 + b1x1 + b2x2 + \cdots + bnxn$$

Equation:

$USR = \beta 1TS + \beta 2PS + \beta 3IS + \mu$

Whereby,

USR= University Students' Readiness for IR4.0

TS= Technical Skills

PS= Problem-solving Skills

IS= Interpersonal Skills

μ= Error / Residual Term

Regression analysis uses statistical metrics to analyse findings. R2 values indicate better model fit, the F-value assesses model importance, the t-value evaluates predictor relevance, and the p-value helps researchers reject or accept a hypothesis, with p-values less than 0.05 indicating a significant relationship (Aydin, 2015; Kasuya, 2019; Mousavi & Parvini, 2016).

3.9 Conclusions

In short, chapter 3 details the study's methodology, which includes a variety of diagnostic tests and models, as well as data analysis with SPSS software. The next chapter will describe and demonstrate the findings of data interpretation based on research questionnaire responses.

CHAPTER 4: DATA ANALYSIS

4.0 Introduction

This chapter presents the results of data analysis using the Statistical Package for Social Science (SPSS) Version 29 software, focusing on descriptive and inferential statistical analyses of sampled respondents to identify correlations and patterns. Then, the presented hypotheses are assessed and discussed in relation to the data analyzed.

4.1 Data Collection

To reach a broader demographic, the study disseminated Google Forms surveys to Utar students via Microsoft Teams as well as to other university and college students using different online channels like Facebook, Instagram, WhatsApp, and Xiaohongshu. The questionnaire URL link and QR code were created and distributed via the social media, achieving a response rate of 98.3%.

4.2 Data Screening

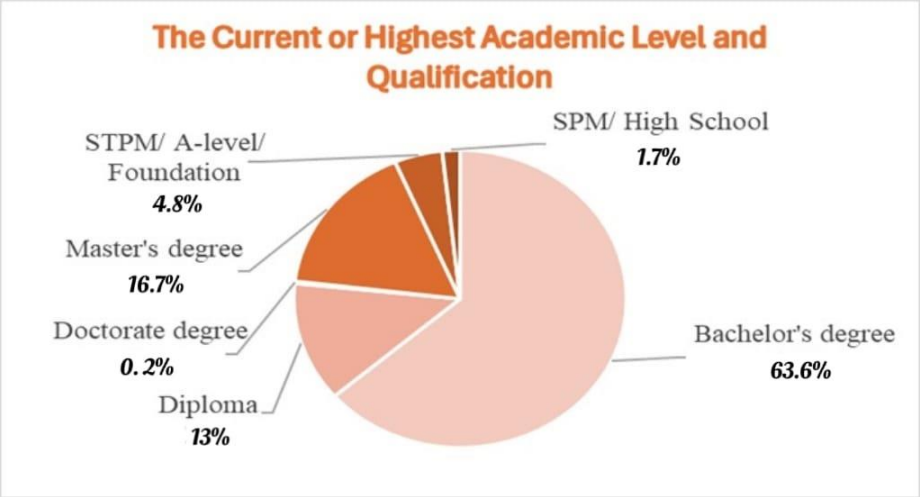
The Google Form distribution had received 407 responses, with only 98.3% viable after filtering out 7 respondents. Thus, the remaining 400 usable data points were loaded into SPSS for data analysis.

4.3 Descriptive Analysis

Descriptive analysis studies improve study comprehension and applicability by gathering personal information such as gender, age, and ethical group, analysing data, and identifying typical trends (Hussain, 2012; Saunders et al., 2009).

4.3.1 Filter Question

Figure 4.1: Filter Question



Source: Developed for the research.

Table 4.1: Filter Question

The current or highest academic level and qualification		
	Frequency	**Percent (%)**
SPM/ High School	7	1.7
STPM/ A-level/ Foundation	19	4.8
Diploma	53	13
Bachelor's degree	259	63.6

Table 4.1 (Cont.)

	Frequency	Percent (%)
Master's degree	68	16.7
Doctorate degree	1	0.2
Total	407	100

Source: Developed for the research.

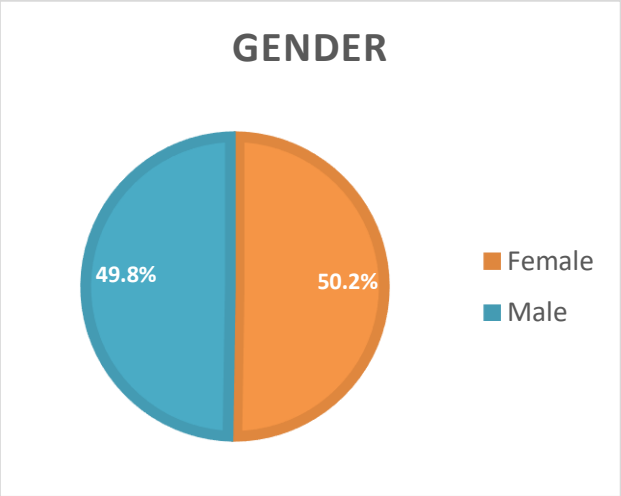
According to Figure 4.1 and Table 4.1, 98.3% of the respondents (N = 400) are qualified respondents who are actively pursuing tertiary education, implying that they are internet users who have interacted with the deployed IR4.0 technology. It includes 19 respondents (4.8%) from STPM, A-level certificate holders, foundation, 53 respondents (13%) from diploma, 68 respondents (16.7%) from master's degrees, and 1 respondent (0.2%) from doctorate degrees. Based on the data, most of the respondents hold a bachelor's degree; that is, 259 respondents, amounting to 63.6% of the total sample. However, seven of the 407 respondents (1.7%) attended just secondary or high school, excluding them from the intended respondents. As a result, only 400 questionnaires will be reviewed for the questions, with seven sets of unqualified data eliminated.

4.3.2 Demographics Profile of the Respondents

Section A of the questionnaire contains information about the respondents' demographics. This part has four (4) questions, including respondents' gender, age, ethnicity, and IR4.0 awareness.

4.3.2.1 Gender

Figure 4.2: Gender (N=400)



Source: Developed for the research.

Table 4.2: Gender (N=400)

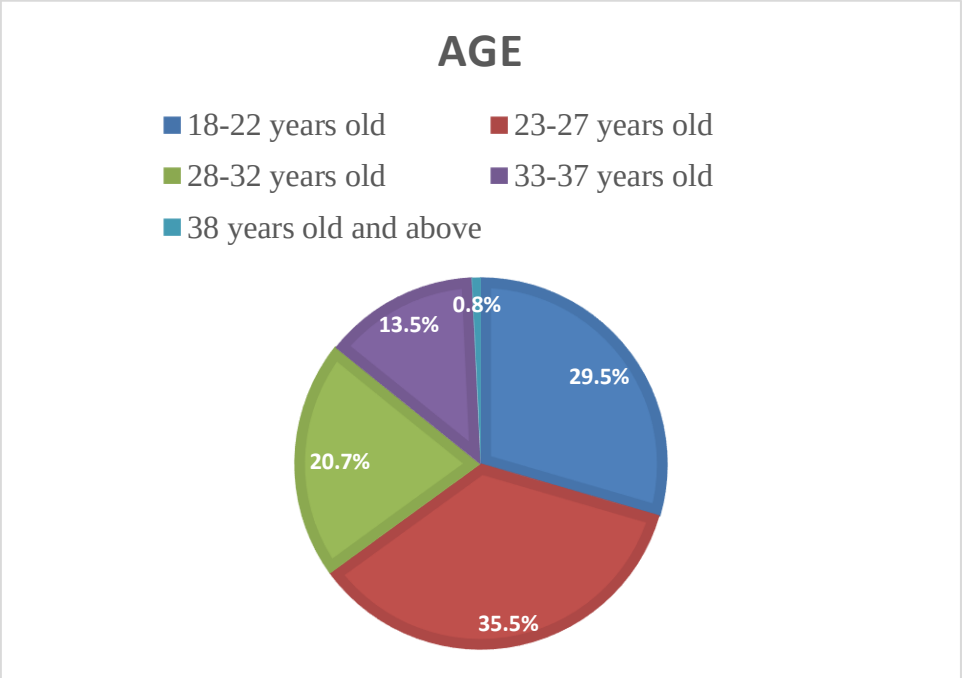
Gender	Frequency	Percent (%)
Male	199	49.8
Female	201	50.2
Total	400	100

Source: Developed for the research.

Figure 4.2 and Table 4.2 demonstrate the study's gender distribution, with 49.8% male (N = 199) and 50.2% female (N = 201), showing about a comparable proportion of male and female participants.

4.3.2.2 Age

Figure 4.3: Age (N=400)



Source: Developed for the research.

Table 4.3: Age (N=400)

Age	Frequency	Percent (%)
18 – 22 years old	118	29.5
23 – 27 years old	142	35.5
28 – 32 years old	83	20.7
33 – 37 years old	54	13.5
38 years old and above	3	0.8
Total	400	100

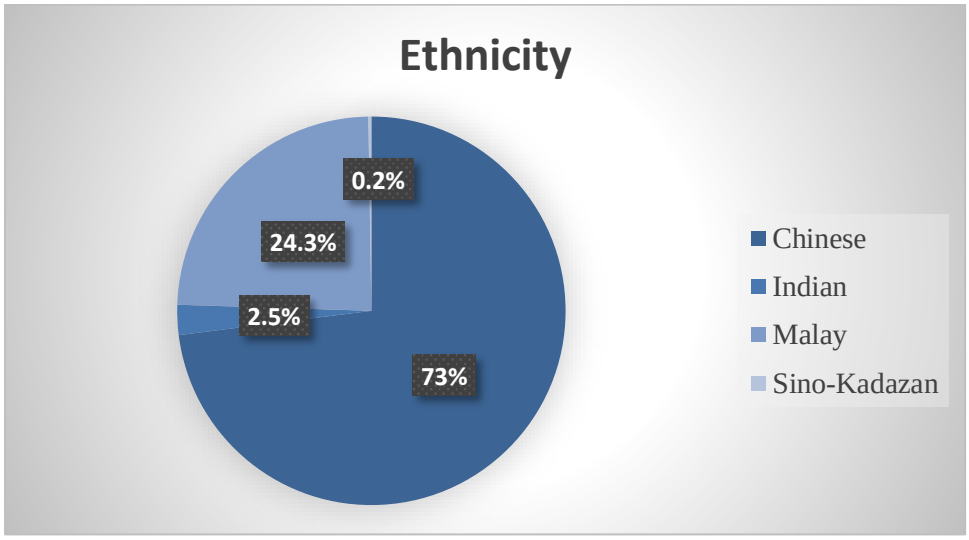
Source: Developed for the research.

According to Figure 4.3 and Table 4.3, a portion of the respondents aged between 18 and 22 years old accounted for 29.5% of the total sample. Next, 142 respondents (35.5%) aged between 23 and 27 years old, followed by 83 respondents (20.7%) that aged between 28 and 32 years old, and 54 respondents (13.5%) aged between 33 and 37 years old. There

were only 3 respondents aged 38 years and older in this study, which accounted for 0.8% of the total sample of the present study.

4.3.2.3 Ethnicity

Figure 4.4: Ethnicity (N=400)



Source: Developed for the research.

Table 4.4: Ethnicity (N=400)

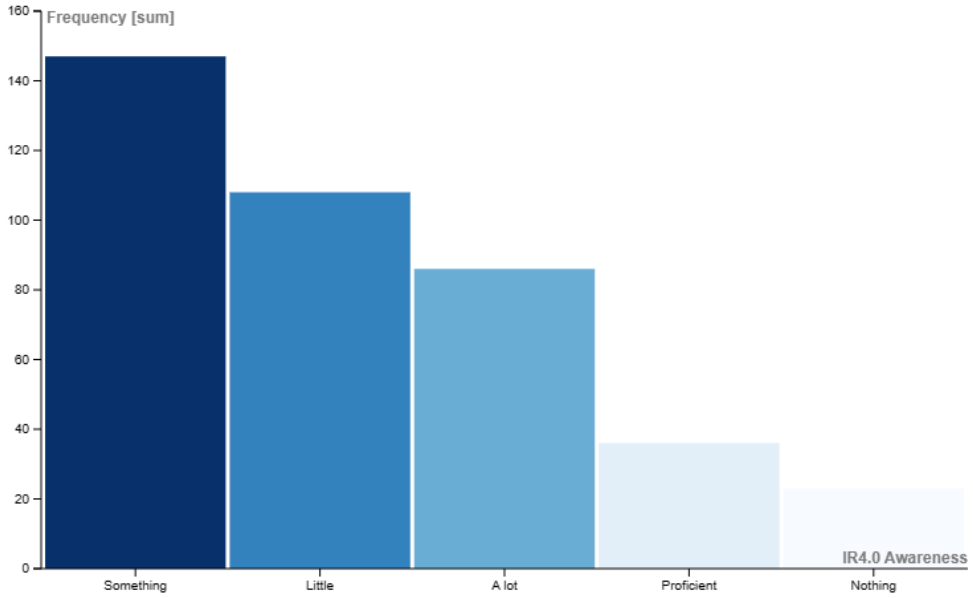
Ethnicity	Frequency	Percent (%)
Chinese	292	73.0
Malay	97	24.3
Indian	10	2.5
Others (Sino-Kadazan)	1	0.2
Total	400	100

Source: Developed for the research.

According to Figure 4.4 and Table 4.4, the majority of the respondents are Chinese and account for 73% of the total sample. Next, 97 respondents (24.3%) are Malay, followed by 10 respondents (2.5%) that are Indian, and there is only 1 Sino-Kadazan respondent (0.2%).

4.3.2.4 IR4.0 Awareness Level

Figure 4.5: IR4.0 Awareness Level (N=400)



Source: Developed for the research.

Table 4.5: IR4.0 Awareness Level (N=400)

IR4.0 Awareness Level	Frequency	Percent (%)
Nothing	23	5.7
Little	108	27
Something	147	36.8
A lot	86	21.5
Proficient	36	9
Total	400	100

Source: Developed for the research.

Figure 4.5 and Table 4.5 depict the respondents' IR4.0 awareness levels. Many respondents (N = 147) had some knowledge about IR4.0,

accounting for 36.8%, with 108 respondents (27%) understanding little about it. Furthermore, 86 (21.5%) respondents claim to know a lot about IR4.0. Furthermore, 23 respondents (5.7%) are unaware of IR4.0, whereas 36 respondents (9%) are knowledgeable about it.

4.3.3 Central Tendencies of Measurement

Central tendency, also known as summary statistics, refers to the tendency of quantitative data to cluster around a central value, rather than dispersion or variability. Measures like the mean, the most widely used measure, aim to explain data by determining its center location, helping us understand a dataset more quickly than examining individual values (Chakrabarty, 2021). Thus, the mean and standard deviation of each variable, including technical skills (TS), problem-solving skills (PS), interpersonal skills (IS), and university students' readiness for IR4.0 (USR), will be detailed in this section to seek an accurate description of all the study data.

4.3.3.1 Mean and Standard Deviation of University Students' Readiness for IR4.0 (DV)

Table 4.6 Mean and Standard Deviation (USR)

Item	Statement	Mean	Standard Deviation
USR1	I am ready to adapt with changes during Industrial Revolution 4.0.	3.78	0.833
USR2	I am ready to apply technical skills in job task required during Industrial Revolution 4.0.	4.11	1.019
USR3	I am ready to learn new knowledge provides by management for Industrial Revolution 4.0.	3.83	1.119

USR4	I am ready to do my tasks in an innovative way towards Industrial Revolution 4.0.	3.98	0.927
USR5	I am ready to attend training provide by the institute for Industrial Revolution 4.0.	4.02	1.015

Source: Developed for the research.

4.3.3.2 Mean and Standard Deviation of Technical Skills (IV1)

Table 4.7 Mean and Standard Deviation (TS)

Item	Statement	Mean	Standard Deviation
TS1	The availability of the electronic resources minimized the time I spent searching for information and knowledge.	3.80	0.946
TS2	I am making extensive use of electronic storage (such as online databases and data warehousing) to access knowledge.	4.30	0.728
TS3	I am using knowledge networks (such as e-group, wiki, forums, virtual learning, etc.) to communicate with other students or specialists in my field.	3.80	1.090
TS4	I share information with my supervisor(s) and colleagues via e-mail, groupware, and intranet, etc.	4.19	1.059
TS5	I can evaluate information, determine its reliability, and build logical conclusions based on digital information and data that come from a virtual environment.	3.49	1.113

Source: Developed for the research.

4.3.3.3 Mean and Standard Deviation of Problem-Solving Skills (IV2)

Table 4.8 Mean and Standard Deviation (PS)

Item	Statement	Mean	Standard Deviation
PS1	I have the ability to recognize alternate routes in meeting objectives that related toward the Industrial Revolution 4.0.	3.47	0.813
PS2	I have the ability to monitor progress toward objectives in risky ventures towards the advance technology application in Industrial Revolution 4.0.	3.96	0.895
PS3	I have the ability to identify potential outcomes when considering risky venture which will simplify my path towards the Industrial Revolution 4.0.	3.68	1.023
PS4	I can take reasonable job-related risks that required for the Industrial Revolution 4.0.	3.98	1.061
PS5	I can adapt to different situations that occur in the industry that advanced in technology 4.0.	3.38	1.050

Source: Developed for the research.

4.3.3.4 Mean and Standard Deviation of Interpersonal Skills (IV3)

Table 4.9 Mean and Standard Deviation (IS)

Item	Statement	Mean	Standard Deviation
IS1	I intensively exchange ideas with other colleagues or lecturers within the school/ center.	3.65	0.917
IS2	I always interact and communicate with other students or groups outside the school/ center.	3.94	1.148
IS3	I actively participate in long-term collaboration	3.55	1.363

	and research activities.		
IS4	My school holds annual discussion forum where students can share knowledge and conduct in-depth discussion among colleagues.	3.77	1.127
IS5	I am good at communicating with my team members.	4.06	0.966

Source: Developed for the research.

4.4 Reliability Analysis

With Likert scales regarded as the most acceptable metric of reliability, the study used the Cronbach Alpha coefficient to examine the internal consistency of the 400 respondents' data values, ensuring consistency across the components of measuring equipment (Bernard, 2002; Huck, 2007). The reliability test results are summarized in a table and discussed further below.

Table 4.10: Reliability results of actual test (N=400)

Variables	No. of Items	Cronbach's Alpha	Reliability Level
IR4.0 Readiness	5	0.908	Very Good Reliability
Technical Skills	5	0.739	Good Reliability
Problem-Solving Skills	5	0.723	Good Reliability
Interpersonal Skills	5	0.892	Very Good Reliability

Source: Developed for the research.

According to Table 4.10, the reliability test for Cronbach Alpha values spans between 0.723 and 0.908. The greatest Cronbach's Alpha ratings are on IR4.0 readiness (0.908) and interpersonal skills (0.892). On the contrary, the lower Cronbach's Alpha levels are technical skills (0.739) and problem-solving skills (0.723). The study's questionnaire is considered credible due to its reliability coefficients meeting or exceeding the internal consistency accuracy requirement of over 0.70 (Cappelleri et al., 2007).

4.5 Inferential Analysis

After assessing the constructs' reliability and validity, the structural model was assessed using SPSS to investigate the associations among variables.

4.5.1 Pearson Correlation Coefficient

Table 4.11: Pearson Correlation Coefficient between Technical Skills (TS) and IR4.0 Readiness (USR)

Correlations

		M_TS	M_USR
M_TS	Pearson Correlation	1	.727**
	Sig. (2-tailed)		<.001
	N	400	400

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Developed for the research, from SPSS software.

The researcher found a positive relationship between Technical Skills (TS) and University Students' IR4.0 Readiness (USR), with a correlation coefficient of 0.727. This indicates that high TS leads to high University Students' IR4.0 Readiness. With a significance level of less than 0.001, the correlation coefficient ranges between ±0.71 and ±0.90, indicating that the correlation is highly significant.

Table 4.12: Pearson Correlation Coefficient between Problem-Solving Skills (PS) and IR4.0 Readiness (USR)

Correlations

		M_PS	M_USR
M_PS	Pearson Correlation	1	.791**
	Sig. (2-tailed)		<.001
	N	400	400

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Developed for the research, from SPSS software.

There is a positive relationship between Problem-Solving Skills (PS) and University Students' IR4.0 Readiness (USR), with a correlation coefficient of 0.791, indicating high PS will contribute to high University Students' IR4.0 Readiness. With a significance level of less than 0.001, the correlation coefficient ranges between ±0.71 and ±0.90, indicating that the correlation is strongly significant.

Table 4.13: Pearson Correlation Coefficient between Interpersonal Skills (IS) and IR4.0 Readiness (USR)

Correlations

		M_IS	M_USR
M_IS	Pearson Correlation	1	.742**
	Sig. (2-tailed)		<.001
	N	400	400

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Developed for the research, from SPSS software.

Interpersonal Skills (IS) have a positive association with University Students' IR4.0 Readiness (USR), concerning a correlation value of 0.742, implying that strong PS will result in high USR. The correlation coefficient, with a significance level of less than 0.001, lies between ±0.71 and ±0.90, suggesting important significance.

4.5.2 Multiple Regression Analysis (MRA)

4.5.2.1 Model Summary

Table 4.14 Interpretation of R square

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.858[a]	.737	.735	.43472
a. Predictors: (Constant), M_IS, M_TS, M_PS				

Source: Developed for the research, from SPSS software.

The study's R Square value of 0.737 in table 4.14 indicates that all independent variables, including technical skills, problem-solving skills, and interpersonal skills, account for 73.7% of the dependent variable's (university students' IR4.0 readiness) variation, indicating a strong explanation for over 73% of the variation. In other words, other factors that may have contributed an additional 26.3% of DV's variation were not included in the study.

4.5.2.2 ANOVA

Table 4.15 Analysis of Variance

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	209.528	3	69.843	369.579	<.001[b]
	Residual	74.836	396	.189		
	Total	284.363	399			
a. Dependent Variable: M_USR						
b. Predictors: (Constant), M_IS, M_TS, M_PS						

Source: Developed for the research, from SPSS software.

This study's ANOVA test assesses regression's ability to fit data and predict variables equally. The regression model accurately predicts outcome variables with statistical validity, as shown in the table 4.15, with a significance level of <0.001.

4.5.2.3 Coefficients

Table 4.16 Parameter Estimates

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.298	.136		-2.185	.029
	M_TS	.381	.042	.314	9.045	<.001
	M_PS	.507	.051	.402	9.864	<.001
	M_IS	.232	.036	.256	6.506	<.001
a. Dependent Variable: M_USR						

Source: Developed for the research, from SPSS software.

Table 4.14 shows the research's coefficient values, with standardized coefficients indicating the most significant independent variable and unstandardized coefficients indicating the effect of unit changes in the independent variable on the dependent variable. The B value indicates that for every 1 unit increase in the independent variable, the dependent variable increases according to the B value. The positive effect is technical skills (0.381), problem-solving skills (0.507), and interpersonal skills (0.232) towards the university students' IR4.0 readiness. It can be explained that with every 1 unit increase in the university students' IR4.0 readiness, technical skills, problem-solving skills, and interpersonal skills

increase by a B value of 0.381, 0.507, and 0.232, respectively. Hence, the equation for multiple linear regressions can be solved by substituting the corresponding values into the given equation:

University Students' IR4.0 Readiness = -0.298 + Technical Skills (0.381) + Problem-solving Skills (0.507) + Interpersonal Skills (0.232)

Thus, problem-solving skills significantly influence university students' IR4.0 readiness, with it being the most influential factor among the other independent variables of technical skills and interpersonal skills.

4.6 Hypothesis Testing

4.6.1 Technical Skills

H1: Technical skills positively influence university students' IR4.0 readiness.

Technical skills have a P-value of <0.001, which is lower than the significant level of 0.05. It will be supported at a 95% confidence interval. Thus, reject the null hypothesis (accept H1). Therefore, this hypothesis is accepted and proves technical skills have a positive relationship with university students' IR4.0 readiness.

4.6.2 Problem-solving Skills

H2: Problem-solving skills positively affect university students' IR4.0 readiness.

Problem-solving skills had a P-value of <0.001, which is below the significant level of 0.05. It will be backed by a 95% confidence interval.

Thus, reject the null hypothesis and accept H2. As a result, this hypothesis is accepted, demonstrating that problem-solving skills correlate positively with university students' IR4.0 preparation.

4.6.3 Interpersonal Skills

H3: Interpersonal skills have a positive impact on university students' IR4.0 readiness.

There is a significant correlation proven between interpersonal skill and university students' IR4.0 preparation, with a P-value of <0.001, which is below the significant level of 0.05, rejecting the null hypothesis and accepting the H3 with a 95% confidence interval.

4.7 Summary

This chapter examines the research model in detail, both descriptively and inferentially, and gives a non-limiting summary. Descriptive analysis focused on the respondents' demographic and historical backgrounds, whereas descriptive analysis scrutinized the outcomes of the measurements and structural models. The measurement model analysis supports the dependability and authenticity of all indicators, and the structural analysis demonstrates that H1, H2, and H3 are acceptable and supporting.

CHAPTER 5: DISCUSSION, CONCLUSION AND IMPLICATIONS

5.0 Introduction

This chapter provides a comprehensive overview of the data analysis, highlighting the study's primary findings, hypothesis testing, implications, limitations, and future research suggestions, and addressing the relationship between independent and dependent variables.

5.1 Discussion of Major Findings

5.1.1 Research Summary

This study investigates the impact of technical skills (TS), problem-solving skills (PS), and interpersonal skills (IS) on Malaysian university students' IR4.0 preparedness. The research uses quantitative techniques with cross-sectional and primary data from 400 respondents in Malaysia. The data was then analysed using SPSS Version 29 software to determine the appropriateness of the model for determining respondents' preparedness for IR4.0 adoption. The results showed that at least one respondent had diverse viewpoints on IR4.0 adoption readiness, classified as strongly agree, agree, neutral, disagree, or strongly disagree. Major findings from the SPSS Version 29 software include:

(i) Technical skills positively influence university students' IR4.0 readiness.

(ii) Problem-solving skills positively affect university students' IR4.0 readiness.

(iii) Interpersonal skills have a positive impact on university students' IR4.0 readiness.

The study reveals that TS, PS, and IS significantly influence IR4.0 preparedness in Malaysia's higher education industry, with respondents indicating a favourable association between these factors.

Table 5.1 Summary of Hypothesis Testing Results

Hypotheses	Value Scored	Significance	Status
H1: Technical skills positively influence university students' IR4.0 readiness.	$\beta = 0.381$ $p < 0.001$	Significant	Supported
H2: Problem-solving skills positively affect university students' IR4.0 readiness.	$\beta = 0.507$ $p < 0.001$	Significant	Supported
H3: Interpersonal skills have a positive impact on university students' IR4.0 readiness.	$\beta = 0.232$ $p < 0.001$	Significant	Supported

Source: Developed for the research.

5.1.2 Findings on Hypotheses

H1: Technical skills (TS) positively influence university students' IR4.0 readiness (USR).

According to Table 5.1, the results suggested that TS has a significant impact on university students' IR4.0 readiness. This is supported by the p-value of less than 0.001 and β-value of 0.381, indicating that H1 is valid

and statistically significant in this study. This finding is in accordance with recent studies that underscore the importance of technical competencies in navigating the complexities of modern industries. The positive influence of technical skills on IR4.0 readiness is evident in the findings of Ahmad et al. (2019), indicating that students with adequate technical skills demonstrate adaptability to technological changes. In the same way, Halili, Fathima, and Razak's (2022) research supports this, stating that proficiency in technical skills enhances employability and prepares students for the complex demands of modern industries in work-based learning settings. While students show modest technical competence, educational institutions must improve training frameworks to better prepare them for IR4.0 challenges and technological improvements (Balan, Zainudin & Jalil, 2021; Rosly er al., 2023).

H2: Problem-solving skills (PS) positively affect university students' IR4.0 readiness (USR).

Based on the results shown in Table 5.1, the β-value and p-value of PS is 0.507 and 0.000 ($p<0.001$) respectively, which shows that there is a significant relationship between PS and USR. PS is also the most important predictor of USR that contributed the highest influence towards university students' IR4.0 readiness in Malaysia. Contrary to expectations, this study did not uncover specific studies exclusively targeting problem-solving skills in the context of IR4.0. However, the broader academic literature confirms the critical role of these skills, particularly cognitive and analytical abilities, in navigating the complexities of IR4.0. Notably, frameworks such as those discussed in the study by González-Pérez and Ramírez-Montoya (2022) emphasize the necessity of enhancing complex reasoning and systemic thinking, which skills are essential for effective problem-solving in IR4.0 environments. Moreover, innovative educational practices leveraging technologies like virtual and mixed reality are increasingly being integrated into curricula. These methodologies not only foster the development of problem-solving skills but also prepare students

to effectively tackle the real-world challenges posed by the evolving technological landscape of IR4.0 (Shuhaimi et al., 2022).

H3: Interpersonal skills (IS) have a positive impact on university students' IR4.0 readiness (USR).

Results in Table 5.1 show that IS has a β-value of 0.232 and a p-value of less than 0.001, indicating a positive relation between IS and USR. Interpersonal skills play a crucial role in preparing students for the demands of the Fourth Industrial Revolution (IR4.0), as they enhance collaboration and communication within technologically advanced environments. Research by Dos Santos et al. (2018) underscores the integration of these soft skills with technical tasks, which enhances adaptability to IR4.0's challenges. Similarly, interpersonal competencies are identified as essential for students facing Industry 4.0, recommending that educational institutions prioritize these areas is crucial for navigating modern industries (Alhloul & Kiss, 2022; Puriwat & Tripopsakul, 2021). Additionally, González-Pérez and Ramírez-Montoya (2022) discuss the integration of educational practices with 21st-century skills to further develop interpersonal skills through character building and meta-learning, essential for IR4.0. These findings collectively advocate for a stronger focus on interpersonal skills within educational frameworks to better prepare students for future industrial demands.

5.2 Implications of the Study

5.2.1 Practical Implications

The Internet of Things (IoT), Internet of Services (IoS), Internet of Data (IoD), and Cyber-Physical Systems (CPS) are all contributing to the rise of Industry 4.0, the era of smart machines and autonomous robots. Malaysia

is gearing up for this transformation by encouraging residents to become more digitally educated, notably in the education sector. Higher education acts as a change agent, and IR 4.0 technology education can assist institutions in preparing for the fourth industrial revolution by increasing student awareness and preparedness for future technologies. Malaysia's Ministry of Higher Education (MoHE) has produced the Malaysia Education Master Plan 2015-2025 (MEB) to integrate education with Industry 4.0, seeking to equip college students and trainees to be well-versed in Industry 4.0 while ensuring they are aware of new industry trends (Maria et al., 2018).

Malaysia confronts a skill barrier owing to a lack of preparation among future employees and companies to embrace the Fourth Industrial Revolution. To overcome this issue, firms must develop "e-skills" in order to increase individual and corporate performance (Balasingham, 2016; Sima, Gheorghe, Subic, & Nancu, 2020). The government should maintain an education system that enables employees and employers to learn and improve creative skills such as critical thinking, problem solving, communication, teamwork, creativity, and innovation (Lase, 2019). In a highly competitive market, professionals must adapt, transform, and alter to keep their jobs. This may be accomplished by redesigning professional and academic programs to improve competencies such as technical knowledge, soft skills, and behavioural development (Kipper et al., 2021). Therefore, this work supports Malaysia's aim to promote research knowledge and convert the country into a competitive and high-income nation, particularly through the development of IR 4.0.

5.2.2 Theoretical Implications

This study contributes significantly to the existing literature on the IR4.0 readiness in HEIs in several ways. Firstly, it addresses a gap by exploring the factors influencing university students' readiness for IR4.0 for future

job employability purposes, emphasizing the technical skills, problem-solving skills, and interpersonal skills. This knowledge fills a gap in understanding determinants of IR4.0 readiness in the education sector among academicians.

The conceptual framework of this study was developed based on Chapnick's Readiness Model. The primary objective is to explore how the readiness of university students for the Fourth Industrial Revolution (IR4.0) is influenced by three constructs, including Technical Skills (TS), Problem-solving Skills (PS), and Interpersonal Skills (IS). Initially, the purpose of this research was to investigate IR4.0 preparation through the lens of skills and competencies as perceived by university students. The focus on this audience is especially important because academics have done little research on this invention, particularly its uptake by Malaysian students. This gap reflects a substantial lack of awareness and information on Malaysian students' perspectives on IR4.0. This study fills gaps in literature and expertise by enhancing our understanding of student awareness and acceptance of advancements, potentially serving as a guide for future research in this field.

Furthermore, the data provide additional evidence that Chapnick's Readiness Model is applicable in the IR4.0 environment. It is critical to adapt existing research models to remain relevant in the face of dynamic environmental changes. This study underlines the importance of continuously refining theoretical models to guarantee that they are relevant and appropriate to changing technological and educational settings. By directly tying these discoveries to wider theoretical and practical consequences, the study not only improves academic discourse but also provides a solid foundation for future empirical research on the subject.

5.3 Limitations of the Study

To begin, this study relied solely on cross-sectional data. The data collected for this study is limited from March 9th to March 31st, 2024. However, the cross-sectional technique is employed to analyse data collected at a certain point in time, making causal inference difficult to distinguish due to the limited time frame. The findings of this study might vary if the investigation is done at an alternative time.

Secondly, the quantitative data collection method is straightforward and fast, but it limits respondents' ability to provide personal opinions or comments on research questions. This is especially true for those who reject the relationship between variables due to closed-ended questions that limit their opinions.

Thus, another drawback is that the universities involved in the research are unvarnished. Researchers initially aim to gather responses from various sorts of universities, including private, public, international, and college. The study will compare respondents and their educational institutions. Due to most respondents coming from private universities, comparisons were not possible.

Lastly, the study did not consider age factors, which could limit the understanding of variations in students' IR4.0 preparation based on age. However, age groups may react differently to and consider IR4.0 technology. The younger generation may be more tech-savvy and expect a flawless virtual experience, while the elderly may be more concerned about security and privacy. Therefore, the acceptance of IR4.0 technology may vary depending on age, with younger individuals more likely to embrace it and older individuals more hesitant.

5.4 Recommendations for Future Research

To start with, this study proposes that future researchers conduct their research using longitudinal data analysis, also known as panel data analysis, considering this method may be utilized to illustrate variables across time. As a result, the

investigator may be able to gather more precise and thorough data while drawing a causal conclusion for their research.

Then, in addition to questionnaires, this study may include other data collection approaches. Future researchers can gather data using methods that are both qualitative as well as quantitative. Using two methods of data gathering in research allows respondents to express their views and provide more useful information.

Besides, for future studies, it is advised that the questionnaire only include private and public universities. This strategy ensures balanced findings from respondents. This allows the researcher to compare responses from both universities. Also, researchers may expand their study's scope and improve its quality.

Finally, future study should include modifiers such as age to examine if these factors influence university students' preparedness for IR4.0 technology. For example, future studies should conduct interviews to ask more thorough questions about respondents' present abilities and competences, desire to use IR4.0 technology, and variables influencing their IR4.0 preparedness. This can assist firms in determining whether the skills and competencies of IR4.0 serve to improve business. Not only that, but generalizations may vary, and some older generations may be equally tech-savvy as younger ones.

In a research topic base, research suggests that universities should engage in comprehensive training programs to prepare for IR4.0 skills and competences in pedagogy and research. Continuous self-improvement and upskilling programs can boost academics' optimism about preparing for IR4.0 successfully. Finally, institutions and governments ought to collaborate collectively to produce comprehensive recommendations for IR4.0 technology integration in education. Clear policies ensuring ethical usage, data protection, and accessibility can serve as an organized foundation for IR4.0 preparation.

5.5 Conclusions

In brief, the study sought to investigate the elements that may impede Malaysia's education sector's preparation for the Fourth Industrial Revolution, which included technical capabilities, problem-solving abilities, and interpersonal skills. After collecting 400 responses from Malaysian tertiary education institutions and administering multiple tests, the study's findings indicate that technical capabilities, problem-solving skills, and interpersonal skills have a major impact on Fourth Industrial Revolution preparation. Hopefully, this conclusion will serve as a reference for other scholars or practitioners interested in studying and observing the awareness and preparation of the Fourth Industrial Revolution in the future.

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APPENDICES

Appendix A: Ethical Approval for Research Report

UNIVERSITI TUNKU ABDUL RAHMAN DU012(A)

Wholly owned by UTAR Education Foundation Co. No. 578227-M

.e: U/SERC/78-212/2024

3 January 2024

)r Fitriya Binti Abdul Rahim
[ead, Department of International Business Faculty of
Accountancy and Management Universiti Tunku
Abdul Rahman
alan Sungai Long Bandar
Sungai Long 43000
Kajang, Selangor

)ear Dr Fitriya,

Ethical Approval For Research Project/Protocol

Ve refer to your application for ethical approval for your students' research project from Bachelor of International Business (Honours) programme enrolled in course UKMZ3016. We are pleased to inform you that the application has been approved under Expedited Review.

'he details of the research projects are as follows:

No.	Research Title	Student's Name	Supervisor's Name	Approval Validity
13.	Adoption Rate of Digital Channel among MSMEs Entrepreneurs. (A Comparison Between Social Commerce and E-Commerce Platforms)	Law Yung Khan	Pn Ezatul Emilia Binti Muhammad Arif	13 January 2024 – 12 January 2025
14.	Factor Affecting Consumers Behavioral Intention to Share Digital Footprints on Social Media	Jenny Leong Siew Yee	Pn Farida Bhanu Binti Mohamed Yousoof	
15.	Factors Affecting the Unemployment Crisis Among Fresh Graduate in Malaysia	Lim Say Siang		
16.	The Buying Behaviour on Green Products - From A Consumer Perspective	Lim Xiao Xuan	Dr Foo Meow Yee	
17.	Factor Affecting Consumer Brand Loyalty on Personal Care Product	Ooi Xin Yi		
18.	Drivers of Employee Retention: A Case Study in Health and Beauty Industry	Tan Chi Ying		
19.	Factors of Remote Work Influencing Remote Work Productivity of Employees in Malaysia	Lee YanZheng	Ms Hooi Pik Hua @ Rae Hooi	
20.	Exploring University Students' Readiness for the Industrial Revolution 4.0: A Conceptualised Framework	Poh Joe Yee	Dr Jayamalathi a/p Jayabalan	

'he conduct of this research is subject to the following:

(1) The participants' informed consent be obtained prior to the commencement of the research;

(2) Confidentiality of participants' personal data must be maintained; and

(3) Compliance with procedures set out in related policies of UTAR such as the UTAR Research Ethics and Code of Conduct, Code of Practice for Research Involving Humans and other related policies/guidelines.

Kampar Campus : Jalan Universiti, Bandar Barat, 31900 Kampar, Perak Darul Ridzuan, Malaysia
Tel: (605) 468 8888 Fax: (605) 466 1313
Sungai Long Campus : Jalan Sungai Long, Bandar Sungai Long, Cheras, 43000 Kajang, Selangor Darul Ehsan, Malaysia
Tel: (603) 9086 0288 Fax: (603) 9019 8868
Website: www.utar.edu.my

Appendix B: Survey Questionnaire

UNIVERSITI TUNKU ABDUL RAHMAN (UTAR)

FACULTY OF ACCOUNTANCY AND MANAGEMENT (FAM)

Bachelor of International Business (HONS) (IN)

Exploring university students' readiness for the Industrial Revolution 4.0: A conceptualised framework

Dear respondents,

Hello, I am Poh Joe Yee, an undergraduate student pursuing Bachelor Degree in International Business (HONS) (IN) at Universiti Tunku Abdul Rahman (UTAR). Currently, I am conducting a study on "Exploring university students' readiness for the Industrial Revolution 4.0: A conceptualised framework" for my final year project. The objective of this research is to investigate the skills or competencies which influences to university students' readiness for the Industrial Revolution 4.0.

This questionnaire consists of three sections and will take approximately 10 to 15 minutes to complete. Please be informed that this survey is strictly for academic purposes and all the information collected will be kept **PRIVATE AND CONFIDENTIAL**. Your participation will behighly appreciated.

Thank you for your time and effort in completing this survey questionnaire.

Student Name	**Student ID**
Poh Joe Yee	2102401

Filtering Question: The current or highest academic level and qualification

( ) SPM/ High School

( ) STPM/ A-level/ Foundation

( ) Diploma

( ) Bachelor's degree

( ) Master's degree

( ) Doctorate degree

PERSONAL DATA PROTECTION NOTICE

Please be informed that in accordance with Personal Data Protection Act 2010 ("PDPA") which came into force on 15 November 2013, Universiti Tunku Abdul Rahman ("UTAR") is hereby bound to make notice and require consent in relation to collection, recording, storage, usage and retention of personal information.

1. Personal data refers to any information which may directly or indirectly identify a person which could include sensitive personal data and expression of opinion. Among others it includes:

a) Name
b) Identity card
c) Place of Birth
d) Address
e) Education History
f) Employment History
g) Medical History
h) Blood type
i) Race
j) Religion
k) Photo
l) Personal Information and Associated Research Data

2. The purposes for which your personal data may be used are inclusive but not limited to:

a) For assessment of any application to UTAR
b) For processing any benefits and services
c) For communication purposes
d) For advertorial and news
e) For general administration and record purposes
f) For enhancing the value of education
g) For educational and related purposes consequential to UTAR
h) For replying any responds to complaints and enquiries
i) For the purpose of our corporate governance
j) For the purposes of conducting research/ collaboration

3. Your personal data may be transferred and/or disclosed to third party and/or UTAR collaborative partners including but not limited to the respective and appointed outsourcing agents for purpose of fulfilling our obligations to you in respect of the purposes and all such other purposes that are related to the purposes and also in providing integrated services, maintaining and storing records. Your data may be shared when required by laws and when disclosure is necessary to comply with applicable laws.

4. Any personal information retained by UTAR shall be destroyed and/or deleted in accordance with our retention policy applicable for us in the event such information is no longer required.

5. UTAR is committed in ensuring the confidentiality, protection, security and accuracy of your personal information made available to us and it has been our ongoing strict policy to ensure that your personal information is accurate, complete, not misleading and updated. UTAR would also ensure that your personal data shall not be used for political and commercial purposes.

Consent:

6. By submitting or providing your personal data to UTAR, you had consented and agreed for your personal data to be used in accordance to the terms and conditions in the Notice and our relevant policy.

7. If you do not consent or subsequently withdraw your consent to the processing and disclosure of your personal data, UTAR will not be able to fulfill our obligations or to contact you or to assist you in respect of the purposes and/or for any other purposes related to the purpose.

8. You may access and update your personal data by writing to us at .

Acknowledgment of Notice

[ ] I have been notified and that I hereby understood, consented and agreed per UTAR above notice.

[ ] I disagree, my personal data will not be processed.

…… Name:
Date:

<u>Section A</u>: Demographic information

Please select **ONE ANSWER** for each question below:

1. Gender

( ) Male

( ) Female

2. Age

( ) 18-22 years old

( ) 23-27 years old

( ) 28-32 years old
( ) 33-37 years old
( ) 38 years old and above

3. Ethnic Group
( ) Malay
( ) Chinese
( ) Indian
( ) Others

4. How much do you know about the Industrial Revolution 4.0?

1 Nothing	2 Little	3 Something	4 A lot	5 Proficient

5-Point Likert Scale

1 Strong Disagree	2 Disagree	3 Neutral	4 Agree	5 Strong Agree

Section B: Questions about Independent Variables (IV).

Technical Skills	1	2	3	4	5
1) The availability of the electronic resources minimized the time I spent searching for information and knowledge.					
2) I am making extensive use of electronic storage (such as online databases and data warehousing) to access knowledge.					
3) I am using knowledge networks (such as e-group, wiki, forums, virtual learning, etc.) to communicate with other students or specialists in my field.					
4) I share information with my supervisor(s) and colleagues via e-mail, groupware, and intranet, etc.					

5) I can evaluate information, determine its reliability, and build logical conclusions based on digital information and data that come from a virtual environment.					

Problem-solving Skills	1	2	3	4	5
1) I have the ability to recognize alternate routes in meeting objectives that related toward the Industrial Revolution 4.0.					
2) I have the ability to monitor progress toward objectives in risky ventures towards the advance technology application in Industrial Revolution 4.0.					
3) I have the ability to identify potential outcomes when considering risky venture which will simplify my path towards the Industrial Revolution 4.0.					
4) I can take reasonable job-related risks that required for the Industrial Revolution 4.0.					
5) I can adapt to different situations that occur in the industry that advanced in technology 4.0.					

Interpersonal Skills	1	2	3	4	5
1) I intensively exchange ideas with other colleagues or lecturers within the school/ centre.					
2) I always interact and communicate with other students or groups outside the school/ centre.					
3) I actively participate in long-term collaboration and research activities.					
4) My school holds annual symposium where students can share knowledge and conduct in-depth discussion among colleagues.					

5) I am good at communicating with my team members.					

Section C: Questions about Dependent Variable (DV).

Student readiness towards Industrial Revolution 4.0	1	2	3	4	5
1) I am ready to adapt with changes during Industrial Revolution 4.0.					
2) I am ready to apply technical skills in job task required during Industrial Revolution 4.0.					
3) I am ready to learn new knowledge provides by management for Industrial Revolution 4.0.					
4) I am ready to do my tasks in an innovative way towards Industrial Revolution 4.0.					
5) I am ready to attend training provide by the institute for Industrial Revolution 4.0.					

Appendix C: Construct Measurement Item

Construct	Sample Measurement Item	Sources
Technical Skills	1) The availability of the electronic resources minimized the time I spent searching for information and knowledge. 2) I am making extensive use of electronic storage (such as online databases and data warehousing) to access knowledge. 3) I am using knowledge networks (such as e-group, wiki, forums, virtual learning, etc.) to communicate with other students or specialists in my field. 4) I share information with my supervisor(s) and colleagues via e-mail, groupware, and intranet, etc.	Zaqout and Abbas (2012)

Problem-solving Skills	1) I have the ability to recognize alternate routes in meeting objectives that related toward the Industrial Revolution 4.0. 2) I have the ability to monitor progress toward objectives in risky ventures towards the advance technology application in Industrial Revolution 4.0. 3) I have the ability to identify potential outcomes when considering risky venture which will simplify my path towards the Industrial Revolution 4.0. 4) I can take reasonable job-related risks that required for the Industrial Revolution 4.0. 5) I can adapt to different situations that occur in the industry that advanced in technology 4.0.	Ahmad, Segaran, Soon, Sapry and Omar (2019)

Interpersonal Skills	1)I intensively exchange ideas with other colleagues or lecturers within the school/ centre. 2) I always interact and communicate with other students or groups outside the school/ centre. 3) I actively participate in long-term collaboration and research activities. 4) My school holds annual symposium where students can share knowledge and conduct in-depth discussion among colleagues.	Zaqout and Abbas (2012)
	5) I am good at communicating with my team members.	Lower, Newman and Anderson-Butcher (2017).

Student readiness towards Industrial Revolution 4.0	1)I am ready to adapt with changes during Industrial Revolution 4.0. 2)I am ready to apply technical skills in job task required during Industrial Revolution 4.0. 3)I am ready to learn new knowledge provides by management for Industrial Revolution 4.0. 4)I am ready to do my tasks in an innovative way towards Industrial Revolution 4.0. 5)I am ready to attend training provide by the institute for Industrial Revolution 4.0.	Ahmad et al. (2019)

Appendix D: SPSS Data Analysis Output

i) Reliability Test

a) Technical Skills

Case Processing Summary

		N	%
Cases	Valid	400	98.8
	Excluded[a]	5	1.2
	Total	405	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.739	.703	5

b) Problem-solving Skills

Case Processing Summary

		N	%
Cases	Valid	400	98.8
	Excluded[a]	5	1.2
	Total	405	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.723	.721	5

c) Interpersonal Skills

Case Processing Summary

		N	%
Cases	Valid	400	98.8
	Excluded[a]	5	1.2
	Total	405	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.892	.895	5

ii) Multiple Regression Analysis

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.858[a]	.737	.735	.43472

a. Predictors: (Constant), M_IS, M_TS, M_PS

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	209.528	3	69.843	369.579	<.001[b]
	Residual	74.836	396	.189		
	Total	284.363	399			

a. Dependent Variable: M_USR

b. Predictors: (Constant), M_IS, M_TS, M_PS

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-.298	.136		-2.185	.029
	M_TS	.381	.042	.314	9.045	<.001
	M_PS	.507	.051	.402	9.864	<.001
	M_IS	.232	.036	.256	6.506	<.001

a. Dependent Variable: M_USR

iii) Pearson Correlation Coefficient

Descriptive Statistics

	Mean	Std. Deviation	N
M_TS	3.9140	.69729	400
M_PS	3.6950	.67000	400
M_IS	3.7935	.93211	400
M_USR	3.9435	.84421	400

Correlations

		M_TS	M_PS	M_IS	M_USR
M_TS	Pearson Correlation	1	.640**	.606**	.727**
	Sig. (2-tailed)		<.001	<.001	<.001
	N	400	400	400	400
M_PS	Pearson Correlation	.640**	1	.735**	.791**
	Sig. (2-tailed)	<.001		<.001	<.001
	N	400	400	400	400
M_IS	Pearson Correlation	.606**	.735**	1	.742**
	Sig. (2-tailed)	<.001	<.001		<.001
	N	400	400	400	400
M_USR	Pearson Correlation	.727**	.791**	.742**	1
	Sig. (2-tailed)	<.001	<.001	<.001	
	N	400	400	400	400

**. Correlation is significant at the 0.01 level (2-tailed).