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EXAMINING PERFORMANCE-RELATED DETERMINANTS AMONG UTAR KAMPAR UNDERGRADUATES IN ADAPTING FIFTH INDUSTRIAL REVOLUTION (IR 5.0) TECHNOLOGIES

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By

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ABSTRACT

EXAMINING PERFORMANCE-RELATED DETERMINANTS AMONG UTAR KAMPAR UNDERGRADUATES IN ADAPTING FIFTH INDUSTRIAL REVOLUTION (IR 5.0) TECHNOLOGIES

THAM SHI YUN

The Fifth Industry Revolution (IR 5.0) embarks on initiatives to solve environmental, social, and economic sustainability related problems. It emphasizes a synergistic partnership between human and smart machines that elevates productivity and ignites innovation at workplace. As IR 5.0 is reaching us soon, this study aims to identify the significant technological and self performance-related determinants among tertiary learners to adapt IR 5.0 technologies in their future workplaces. Technological performance-related determinants involve tertiary learners' self-efficacy, perceived ease of use, perceived importance, behavioural intention to use, technological knowledge base and job performance expectancy on IR 5.0 technologies. Self performance-related determinants include tertiary learners' life-long learning tendency, critical thinking, communication, collaboration, creativity, and problem-solving skills. Besides, this study examines inter-relationships among these determinants to provide valuable insights into the multifaceted dynamics that shape tertiary learners' proficiency and uptake of IR 5.0 technologies. In pursuit of these research goals, quantitative research via questionnaire survey was deployed. The study targets second-year and above undergraduates at Universiti Tunku Abdul

Rahman (UTAR) Kampar by using multi-stage cluster sampling to select respondents from five faculties. A multi-staged cluster sampling technique was employed to select respondents from the five faculties. The questionnaire used in the study was compiled and adapted from recent literature sources. A total of 187 responses collected were analyzed using Partial Least Squares-Structural Equation Modelling (PLS-SEM). From the technological performance-related determinants analyzed, tertiary learners' self-efficacy, behavioural intention to use and technological knowledge base have significant influence on their readiness to adapt IR 5.0 technologies in their future workplaces. Furthermore, the relationship between perceived ease of use and behavioural intention to use IR 5.0 technologies is partially mediated by their perceived importance of these technologies. Based on tertiary learners’ self performance-related determinants studied, tertiary learners’ creativity skills significantly influence their readiness to adapt IR 5.0 technologies.

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DECLARATION

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

THAM SHI YUN

APPROVAL SHEET

This project report entitled "**Examining Performance-Related Determinants of UTAR Kampar Undergraduates in Adapting Fifth Industry Revolution (IR 5.0) Technologies**" was prepared by THAM SHI YUN and submitted as partial fulfilment of the requirements for the degree of Bachelor of Science (Hons) Statistical Computing and Operations Research at Universiti Tunku Abdul Rahman.

Approved by:

(Mr YEOH HONG BENG) Date: 4/9/2024

Supervisor

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Date: 4 SEPTEMBER 2024

PERMISSION SHEET

It is hereby certified that **THAM SHI YUN** (ID No: **20ADB04670**) has completed this final year project entitled "**EXAMINING PERFORMANCE-RELATED DETERMINANTS AMONG UTAR KAMPAR UNDERGRADUATES IN ADAPTING FIFTH INDUSTRIAL REVOLUTION (IR 5.0) TECHNOLOGIES**" under the supervision of **MR. YEOH HONG BENG** (Supervisor) from the Department of Physical and Mathematical Science, Faculty of Science.

I hereby give permission to the University to upload the softcopy of my final year project in pdf format into the UTAR Institutional Repository, which may be made accessible to the UTAR community and public.

Yours truly,

(THAM SHI YUN)

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LIST OF ABBREVIATIONS

AVE	Average Variance Extracted
BIU	Behavioural Intention to Use IR 5.0 Technologies
CB-SEM	Covariance Based Structural Equation Modeling
CI	Confidence Interval
CollS	Collaboration Skills
CommS	Communication Skills
CreaS	Creativity Skills
CRI	Composite Reliability Index
CSV	Comma-Separated Value
CTS	Critical Thinking Skills
FAS	Faculty of Arts and Social Science
FBF	Faculty of Business and Finance
FEGT	Faculty of Engineering and Green Technology
FICT	Faculty of Information and Communication Technology
FSC	Faculty of Science
H_0	Null Hypothesis
H_a	Alternative Hypothesis
JPE	Job Performance Expectancy on IR 5.0 Technologies
LL	Life-long Learning Tendency
LLM	Large Language Models
LM	Linear Regression Model
MCA	Malaysian Chinese Association

PEU	Perceived Ease of Use on IR 5.0 Technologies
PI	Perceived Importance
PLS-SEM	Partial Least Square-Structural Equation Modeling
PSS	Problem Solving Skills
R	Readiness of Tertiary Learners to Adopt IR 5.0 Technologies
RMSE	Root Mean Square Error
SE	Self-Efficacy
TAM	Technology Acceptance Model
TKB	Technological Knowledge Base
TPACK	Technological Pedagogical Content Knowledge
UTAR	Universiti Tunku Abdul Rahman
VAF	Variance Accounted For
VIF	Variance-Inflation Factor
ρA	Dijkstra-Henseler's rho

CHAPTER 1

INTRODUCTION

Chapter 1 describes background of studied organization and outlines research problem statement, objectives, significance, and limitations. At the end of the chapter, the related contributing determinants towards the readiness of tertiary learners to adapt Fifth Industry Revolution (IR 5.0) technologies are defined and elaborated.

1.1 Introduction

Human interactions with technology started with early innovations such as fire and primitive tools (Ziatdinov, Atteraya, and Nabiyev, 2024). Over times, technology has evolved through several key phases, namely from pre-industrial revolution to the different eras of the industrial revolution. These eras of industrial revolution have brought about important changes and influences in how we live and work. They are crucial for improving human quality of life.

The journey of Pre-Industrial Era began before 1760. It was characterized by simple and manual labour with tools like the loom and basic farming equipment (Core Knowledge, 2018; Stearns, 2023). It was followed by First Industrial Revolution era, which was known as agriculture age, that happened in between 1780 and 1850. Steam power and mechanization such as the steam engine and spinning jenny were introduced. These innovations led to the rise of factories and manufacturing productions (Stearns, 2023; Mohajan, 2019a; Ali, Ayad, and

Rubaie, 2022; Kim, 2024). Second Industrial Revolution era (1850-1950), referred as industrial age, saw major paradigm shift on the productions of Bessemer process for steels, electric light bulbs and internal combustion engines, as well as significant progresses in chemical industries and electrical communication (Stearns, 2023; Mohajan, 2019b; Kim, 2024). After that, Third Industrial Revolution era, also known as the information age, was undergone a shift from mechanical and analog technologies to digital electronics over the period of 1950 - 2000. This era was driven by computers, information technology and manufacturing automation with the introduction of technologies such as microprocessors, robotics, nanotechnology, biotechnology, 3D printing, and artificial intelligence (Stearns, 2023; Mohajan, 2021; Kim, 2024). The Fourth Industrial Revolution (IR 4.0) started in 2000 until present. It is characterized by the integration of digital technologies with physical systems. Big Data Analytics, Artificial Intelligence, the Internet of Things, and Cloud Computing form the backbone technologies in IR 4.0 era (Stearns, 2023; Yeoh et al., 2023). These technologies enhance connectivity, automation, and the application of advanced robotics in the service and manufacturing industries (Ujakpa et al., 2020).

According to the comparison by Noble et al. (2022), IR 4.0 focuses on maximizing technological capabilities and their interconnectedness. These efforts lead to digitalizing and automating industrial processes that boost productivity and economic growth. However, humans have to compete with machines for jobs as business entities deploy IR 4.0 technologies for profit maximization. In contrast, IR 5.0 technologies seek to harmonize and leverage human-machine collaboration and strengths to enhance productivity (Santhi and Muthuswamy, 2023; Ziatdinov, Atteraya, and Nabiyev, 2024). It emphasizes environment, social and economic sustainability with the responsible usage of resources and pursuing profits with the aim to achieve economic, social and environmental sustainability (Ghobakhloo et al., 2024; Destouet et al., 2023). Moreover, IR 4.0 related technologies required human involvements and interventions for automating tasks and decision-making (Yeoh et al., 2023). In contrast, advanced AI technologies in IR 5.0 are able to learn autonomously from real-time data without requiring human input for algorithm training. For instance, Cyber Physical systems integrate digital systems to perform precise diagnostics and computational tasks as well as enhance real-time automation and control of healthcare facilities and services (Ziatdinov, Atteraya, and Nabiyev, 2024).

Currently, Malaysia is in IR 4.0 era. However, IR 5.0 is imminent as advancements in technologies are accelerating exponentially over times. Although IR 5.0 does not yet have clear defined characteristics, there still have existing literature that provides insights on emerging concepts and applications of IR 5.0 related technologies (Ghobakhloo et al., 2024). According to Ali, Ayad, and Rubaie (2022), IR 5.0 era focuses on blending advanced technologies with human creativity and empathy, emphasizing sustainability, evolving nanotechnology, integrating artificial intelligence with the ethical considerations and enhancing human well-being. Besides, IR 5.0 related technologies enhance manufacturing processes by fostering collaboration between humans and smart machines (Noble et al., 2022). This synergy boosts productivity and drives innovation in the workplace.

The main concept of IR 5.0 involves maintaining and enhancing environmental, social and economic sustainability (Kim, 2024). Environmental sustainability focuses on reducing carbon emissions by having green technologies that are friendly to our nature and biodiversity (Kim, 2024). Companies and manufacturers would focus on sustainable and eco-friendly practices to reduce environmental impact on the globe (Mustapic et al, 2023). The development of biofuels and biochemicals that eliminate greenhouse gas emissions, alongside with the rise of electric vehicles and companies like Tesla exemplify paradigm shift towards environmental sustainability (Maradin, Malnar, and Kaštelan, 2022). On the other hand, social sustainability aims to enhance human well-being and foster equitable social systems for all (Kim, 2024). Social sustainability also encompasses trends like remote work and urban migration, which have gained momentum, especially in post-pandemic COVID-19 era (Kim, 2024). This social shift prioritizes improvement of human quality of life, fostering inclusivity, and ensuring societal advancement benefits for all members in the societies. Besides, economic sustainability drives economic growth that integrates social and environmental considerations for long-term human prosperity by balancing human needs and environmental protection (Kim, 2024).

1.2 Background of the Research

This research targets undergraduate students from all five faculties at Universiti Tunku Abdul Rahman (UTAR) Kampar Campus, namely Faculty of Arts and Social Science (FAS), Faculty of Business and Finance (FBF), Faculty of

Engineering and Green Technology (FEGT), Faculty of Information and Communication Technology (FICT), and Faculty of Science (FSC).

The main objective of this research is to identify the performance-related determinants that contribute towards adaption of IR 5.0 technologies among tertiary learners at their future workplaces. This research also studies the inter-relationships among these performance-related determinants that facilitate adaptation of IR 5.0 related technologies among tertiary learners.

1.3 Background of the Research Organization

Kolej Tunku Abdul Rahman (KTAR) was founded by the Malaysian Chinese Association (MCA) in 1964. Its first campus opened in 1972 in Setapak, Kuala Lumpur. In 2001, MCA initiated the development of Universiti Tunku Abdul Rahman (UTAR) in response to an invitation from the Malaysia's Minister of Education. UTAR was officially launched in 2002 and started to offer eight degree programmes across three faculties, namely Faculty of Accountancy and Management (FAM), Faculty of Arts and Social Science (FAS) and Faculty of Information and Communication Technology (FICT) (UTAR, n.d.).

Currently, UTAR operates two campuses which are located in Bandar Sungai Long, Selangor, and Kampar, Perak. It offers over 138 academic programmes, including Foundation Studies, Bachelor's, Postgraduate Diplomas, Master's, and PhD degrees across nine faculties. The 1,300-acre site of Kampar campus was provided by Perak State Government. It has five faculties namely Faculty of Arts and Social Science (FAS), Faculty of Business and Finance (FBF), Faculty of Engineering and Green Technology (FEGT), Faculty of Information and Communication Technology (FICT) and Faculty of Science (FSC) (UTAR, n.d.).

This research focuses on UTAR Kampar campus as it offers extensive range of arts and science academic programmes. This diversity enables the study to examine performance-related determinants of adaptation to IR 5.0 technologies among tertiary learners from different disciplines of study.

1.4 Problem Statement of the Study

Malaysia officially entered IR 4.0 in 2021 (National 4IR Policy, 2021). As technological advancements are occurring at an accelerated pace nowadays, arrival of the IR 5.0 is imminent to the country. In the onset of the IR 5.0, tertiary learners will soon encounter another transformative era that is characterized by a new industrial and technological paradigm. This forthcoming transition presents both opportunities and challenges for tertiary learners. They need to adapt to these evolving technological demands in their future professional career. Despite the urgency and relevance of this transition, there is a noticeable research gap in focusing on performance-related determinants that affect tertiary learners' adaptation to IR 5.0 technologies. On top of it, currently there is a limited amount of research on examining the inter-relationships among determinants that influence tertiary learners' readiness in adapting IR 5.0 technologies.

1.5 Objectives of the Study

This research has two primary objectives. Firstly, the research aims to identify the performance related determinants that contribute towards tertiary learners' readiness to adapt IR 5.0 technologies. Secondly, this study aims to examine the inter-relationships among these performance-related determinants that impact on readiness of tertiary learners to adapt IR 5.0 technologies.

1.6 Significance of the Study

The results of this study offer valuable insights for undergraduates at UTAR Kampar on what and how to improve their readiness to adapt IR 5.0 technologies in their future careers. By focusing on the significant determinants identified in the research findings, tertiary learners can better prepare themselves for IR 5.0 technologies that they will encounter in their future workplaces. Besides, understanding the inter-relationships among these factors allows tertiary learners to strategically enhance their skills and learning tendency to well equip themselves in the evolving landscape of globalization and technological advancement in IR 5.0 era.

Furthermore, this study provides a clearer vision for lecturers at UTAR particularly and other higher education institutions generally to incorporate required skills and competencies in their teaching and learning in order to prepare tertiary learners for adaptation of IR 5.0 technologies. Lecturers can enhance their instructional approaches to facilitate the significant determinants that impact tertiary learners' readiness to adapt to IR 5.0 technologies such as, 21st century skills and life-long learning tendency. Emphasizing on these skills in teaching and learning will equip tertiary learners with the essential knowledge and skills that are needed to effectively adapt to the emerging technologies in IR 5.0 era.

In addition, this study highlights key determinants that influence tertiary learners' readiness to adapt IR 5.0 technologies to the management of UTAR, other private and public universities locally and internationally. With these research findings, the university's management is able to identify skill gaps among its students and then initiate action plans such as updating curriculum and co-curriculum activities in line with the latest technological development and knowledge base, fostering students' involvement in extracurricular clubs and societies to facilitate the development of 21st century skills and providing relevant trainings, talks and seminars in the emerging IR 5.0 related technologies. Academic program's course structure and syllabus shall be updated from times to times to reflect the usage and applications of emerging technologies in IR 5.0 era so that tertiary learners are better equipped with necessary skills and knowledge that are needed in their future endeavours.

Besides, the findings of the research provide an insight for the Ministry of Higher Education (MoHE) in Malaysia to approve tertiary academic programs that are specifically designed to address the knowledge and skills required in IR 5.0 era via Malaysian Qualifications Agency (MQA). Other than that, MoHE's Malaysia Greater Research Network System (MyGRANTS) could establish specific criteria for grant applications that place greater emphasis on research related to emerging technologies in IR 5.0 era (Ministry of Higher Education, 2021). This effort will foster quality research on what and how to enhance tertiary learners' preparedness towards IR 5.0 technologies in their future careers. On top of it, the research results can serve as a fundamental basis for research communities to engage in further studies related to the adaptation of IR 5.0 technologies among tertiary learners.

1.7 Limitations of the Study

This research has several limitations. It is specifically focused on the perspectives of undergraduate students at UTAR Kampar Campus. Its findings may not reflect the views of undergraduates from all higher education institutions in Malaysia. Furthermore, the study exclusively involves undergraduate students. As a result, the findings may not fully capture responses across different levels of higher education, such as foundation, diploma, advanced diploma and postgraduate students in tertiary educational institutions. Additionally, the technological and self performance-related determinants analyzed in relation to tertiary learners' readiness to adapt to IR 5.0 technologies are primarily based on recent literature. As new technologies emerge over times, the contributing determinants toward adaption of IR 5.0 technologies might need to be regularly refined, explored, and updated. Lastly, this research does not encompass detailed dimension and applications of IR 5.0 technologies. There will be a lot of research potentials to be focused on over times, particularly in the emerging technological trends and innovations in the era of IR 5.0.

1.8 Definitions and Descriptions of Contributing Determinants Towards Readiness of Tertiary Learners to Adapt IR 5.0 Technologies.

This study examines the determinants affecting tertiary learners' readiness to adopt IR 5.0 technologies. These determinants are categorized into two main dimensions, namely technological and self performance-related determinants. Tertiary learners' technological performance-related determinants pertain to aspects such as their behaviours and competencies to adapt with technological change. These determinants encompass how well learners engage with and utilize technological tools and innovations. Yeoh and Yap (2024) identified several technological determinants that affect tertiary learners' adaptation to IR 4.0 technologies, namely their self-efficacy to use the technology, technological job performance expectancy and technological acceptance levels. Ramírez, Cañón, and Ayerbe (2007) do mention that technological knowledge base is required for individuals to adapt to a new working environment driven by technologies. In this study the acceptance level of IR 5.0 technologies by tertiary learners is assessed using the Technology Acceptance Model (TAM). The TAM model evaluates key factors that are critical for the adoption of a new technology, namely perceived ease of use and importance of the technology as well as behavioural intention to use it (Javidnia, Nasiri, and Jamshid, 2012).

On the other hand, self performance-related determinants include factors associated with learners' attitudes towards learning and their related learning skill sets. The research addresses tertiary learners' life-long learning tendency and 21st century learning skills. Lifelong learning refers one's tendency to continuously pursue knowledge and skills throughout his/her life. 21st century skills are crucial abilities that enable individuals to succeed in a rapidly changing and disruptive working environment (Marbach-Ad, Hunt, and Thompson, 2019; McGunagle and Zizka, 2020). According to Dass (2014), these skills are essential for students to keep pace with new technological advancements and shifts.

1.8.1 Tertiary Learners' Technological Performance-Related Determinants

In this section, tertiary learners' technological performance-related determinants covered in this research, namely their self-efficacy to use IR 5.0 technologies, perceived ease of use, importance and behavioural intention to use them as well as their technological job performance expectancy and knowledge base, are further defined and evaluated.

1.8.1.1 Self-Efficacy

Self-efficacy refers to belief of an individual in his or her own ability to successfully perform specific tasks or achieve targeted goals set (Mookkiah and Prabu, 2019; Latip et al., 2020). Kulviwat, Bruner, and Neelankavil (2014) highlighted that confidence in managing complex technological innovations significantly impacts emotional and cognitive responses to these advancements. In this research, tertiary learners' self-efficacy measures their level of confidence to manage, leverage and adapt IR 5.0 technologies at their future workplaces.

1.8.1.2 Perceived Ease of Use

Perceived ease of use refers to the perception of users on how simple it is to use a new technology (Javidnia, Nasiri, and Jamshid, 2012). According to Davis et al. (1989) and Yeoh et al. (2023), users are more likely to adopt and integrate technologies into their daily routines if they find them easy to use. In this study, tertiary learners' perceived ease of use of IR 5.0 technologies is defined as their belief that these technologies are user-friendly and required less mental effort to master them.

1.8.1.3 Perceived Importance

Perceived importance refers to the extent to which tertiary learners believe that it is important to adapt a new technology for better performance in carrying out their daily activities and tasks. According to Davis et al. (1989), this concept highlights the user's perception on a technology's potential to improve his/her job efficiency and effectiveness. When users recognize a technology as beneficial to boost their job performance, they have more tendency to accept and integrate it into their work processes (Yeoh et al., 2023). In this study, perceived importance denotes the level to which tertiary learners believe that IR 5.0 technologies are useful, valuable and imperative for their future careers.

1.8.1.4 Behavioural Intention to Use

Behavioural intention to use describes an individual’s level of acceptance to adopt a new technology (Aditia et al.,2018). Tertiary learners’ behavioural intention to use a new technology would be influenced by both perceived importance and perceived ease of use of the technology. If users perceive that a new technology is beneficial to improve their job performance, they are more likely to develop a positive attitude towards using it (Javidnia, Nasiri, and Jamshid, 2012). In this research, tertiary learners’ behavioural intention to use

IR 5.0 technologies is reflected by their willingness to engage with technologies and utilize them in their future workplaces.

1.8.1.5 Technological Job Performance Expectancy

Technological job performance expectancy refers to tertiary learners' expectations regarding how effectively they will perform their job responsibilities with the aid of technology (Venkatesh et al., 2003). Generally, users expect that technologies can bring about improvement to their work performance in terms of enhanced productivity, efficiency, and upskilling of competency to handle complex tasks that rely on usage of advanced technological tools (Yeoh and Yap, 2024). In this research, tertiary learners' technological job performance expectancy is measured by their perceptions on the usage of IR 5.0 technologies bring about better job opportunities and remunerations, improved time and effort efficiency at workplace and enhanced flexibility to adapt to ever-changing working environment in their future careers.

1.8.1.6 Technological Knowledge Base

Technological knowledge base is a collection of users' resources that facilitate the leverage and deployment a new technology (Avanci and Ruiz, 2021). It includes up-to-date understanding of technological processes, methods and knowledge. This knowledge base is made up of interconnected pieces of information that work together to address organizational processes and operations that are driven by technologies. As technology evolves, the knowledge base has to be updated and extended. In this study, tertiary learners' technological knowledge base refers to their development and update on the knowledge of IR 5.0 technologies over times.

1.8.2 Tertiary Learners' Self Performance-Related Determinants

In this section, the tertiary learners' self performance-related determinants, namely tertiary learners' life-long learning tendency and their critical thinking skills, collaboration skills, communication skills, creativity skills, and problem-solving skills are defined and elaborated.

1.8.2.1 Life-Long Learning Tendency

Life-long learning is the continuous, voluntary, and self-motivated pursuit of knowledge, skills, and interests throughout an individual's life (Richardson, 1978). It involves active engagement in various formal and informal learning activities that contribute to ongoing personal and professional development, fostering continuous growth and adaptability to changes in the environment (Demirel, 2009). Tertiary learners' life-long learning tendency is essential for them to face challenges due to future technological advancements or shift. It can assist them to stay ahead by continuously updating their skills and knowledge in order to keep in pace with the ever-changing world. This research measures respondents' tendency of life-long learning in terms of their self-directed learning tendency and learning goal setting.

1.8.2.2 Critical Thinking Skills

Critical thinking skills involve the process of evaluating information, reasoning, and situations to develop insightful knowledge and understanding (Heard et al., 2020). It involves synthesizing information effectively to make informed decisions and solve problems (Hakim, Sariyatun, and Sudiyanto, 2018). As mentioned by Kocak and Göksu (2020), critical thinking skills are characterized by greater clarity, accuracy, consistency, and overall improvement in thinking. In this research, critical thinking skills refers to the ability of tertiary learners to evaluate ideas and arguments before suggesting new perspectives in the attended meetings and discussions.

1.8.2.3 Communication Skills

Communication skills refer to an individual's ability to effectively exchange information and ideas across various formats and platforms (Maican, 2019). According to Pattiwael (2016), communication skills are vital to facilitate collaboration across diverse sectors and entities and enable sharing of issues among participants in meetings and discussions. Effective communication involves not only clear and concise message delivery but also the adaptability of communication strategies to suit different audiences and mediums of communications. In this research, the communication skills of tertiary learners are defined as their ability to effectively present their views and receive information from others in their workplaces.

1.8.2.4 Collaboration Skills

Collaboration skills refer to an individual's ability to work effectively with others to achieve common goals (Yeoh and Yap, 2024). Collaborative learning provides learners with opportunities to compare and contrast perspectives, present and defend ideas, and exchange diverse beliefs with teammates (Child and Shaw, 2016; Riaz and Din, 2023) This process involves teamwork to enhance understanding and achieve common objectives in the grouped assignment/project. In this research, tertiary learners' collaboration skills are defined by their ability to work as a team and having mutual respect to other team members to achieve common goals in grouped project assigned.

1.8.2.5 Creativity Skills

Creativity skills are defined as the abilities that enable individuals to generate innovative ideas, think outside the box, and solve problems in novel ways (O'Hara, 2017). These skills are crucial in an era that is characterized by rapid technological advancement and disruptive working environment, as they enable individuals to foster innovation to ongoing institutional transformations and technological revolutions (Primi and Wechsler, 2018). In this research, tertiary learners' creativity skills are manifested by their ability to envision and develop new and original ideas in their future careers.

1.8.2.6 Problem-Solving Skills

Problem-solving skills are the abilities to identify, analyze, and resolve issues raised effectively and efficiently (Bariyyah, 2021). Tertiary learners are required to have strong problem-solving skills to effectively address and resolve the difficulties they encounter. In the 21st century, abundant information and advanced technologies are available to assist in developing solutions to the problems faced at the workplace (Arya and Nardon, 2014). In this research, tertiary learners' problem-solving skills are defined as their capability to address and resolve problem on ad hoc basis by selecting and evaluating alternative solutions available.

CHAPTER 2

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

In this research, the studied contributing factors that influence tertiary learners' adoption of IR 5.0 technologies are divided into two main categories, namely technological and self performance-related determinants. Tertiary learners' technological performance-related determinants reflect their behaviours, traits, and knowledge base regarding to the usage of emerging technologies. They are perceived importance, perceived ease of use, behavioural intention to use, technological self-efficacy, job performance expectancy and knowledge base. On the other hand, self performance-related determinants influence how individual learners interact with and adapt to new technologies. They highlight individual life-long learning tendency and 21st century learning skills, namely critical thinking skills, collaboration skills, communication skills, creativity skills, and problem-solving skills.

Chapter 2 presents a review of the literature concerning the influencing determinants and their inter-relationships towards tertiary learners' technology's adaptation of IR 5.0 technologies at their future workplaces. It is followed by the development of related research hypotheses. The chapter ends with the establishment of the research theoretical framework that aligns with the proposed hypotheses.

2.1 Technological Performance-Related Determinants for Tertiary Learners' Adaptation of IR 5.0 Technologies.

This section examines the inter-relationships among technological performance-related determinants, namely self-efficacy, perceived ease of use, importance, behavioural intention to use, technological job performance expectancy and knowledge base, and their impacts on the adoption of IR 5.0 technologies among tertiary learners in their future careers. Related hypotheses are constructed to address inter-relationships among determinants and their effects on readiness of tertiary learners to adapt IR 5.0 technologies in their future workplaces.

2.1.1 Effect of Tertiary Learners' Self-Efficacy to Use IR 5.0 Technologies on Their Adaptation of the Technologies in Their Future Workplaces.

According to Celik and Yesilyurt (2013), an individual's self-efficacy significantly and positively affects their acceptance and usage of new technology. Individuals with higher self-efficacy are more likely to adopt and utilize new technological tools at their workplaces (Kulviwat, Bruner, and Neelankavil, 2014). Users' technological self-efficacy not only increases their chances in accepting and using new technologies but also helps them to adapt to new technological innovations and integrate them into their workplaces. Ultimately, enhanced users' self-efficacy in IR 5.0 technologies is expected to facilitate more successful adaptation to these technologies. Therefore, the following hypothesis is proposed.

$H_{a1:}$ Tertiary learners' technological self-efficacy has significant effect on their adaptation of IR 5.0 technologies at their future workplaces.

2.1.2 Effect of Tertiary Learners' Perceived Ease of Use of IR 5.0 Technologies on Their Self-Efficacy, Perceived Importance, Behavioural Intention to Use and Technological Job Performance Expectancy on Using These Technologies.

According to He et al. (2018), an individual's perceived ease of use of a technology affects his/her self-efficacy. When the users find a technology easy to use, they feel more confident in their ability to handle it effectively. Besides, the perceived ease of use of a technology indirectly affects users' perceived importance and behavioral intention to adopt it (Venkatesh and Davis, 2000; Venkatesh and Bala, 2008). If a technology is perceived as user-friendly, the users are more likely to believe that they can operate it with less effort. Upon leveraging a technology, users will realize the usefulness, importance and value of the technology. At the same time, the user's behavioural intention to use the technology will be boosted. Tertiary learners' perceived ease of use of a technology significantly affects their technological job performance expectancy because when they find a technology or tool easy to use, they anticipate that it significantly improve their job performance (Omar et al., 2019). Thus, the following hypotheses are initiated.

$H_{a2:}$ Tertiary learners' perceived ease of use of IR 5.0 technologies has significant effect on their self-efficacy to use the technologies.

$H_{a3:}$ Tertiary learners' perceived ease of use of IR 5.0 technologies has significant effect on their perceived importance of the technologies.

$H_{a4:}$ Tertiary learners' perceived ease of use of IR 5.0 technologies has significant effect on their behavioural intention to use the technologies.

$H_{a5:}$ Tertiary learners’ perceived ease of use of IR 5.0 technologies has significant effect on their job performance expectancy on the technologies.

2.1.3 Effect of Tertiary Learners’ Perceived Importance of IR 5.0 Technologies on Their Technological Self-Efficacy, Behavioural Intention to Use and Job Performance Expectancy When Using the Technologies.

According to Yeoh et al. (2023), users’ perceived importance of a technology influences their self-efficacy by enhancing users' motivation and confidence. When individuals view a technology as a valuable and essential tool, they are more motivated to engage with it and invest effort to master it. This heightened motivation fosters a stronger belief in their own ability to use IR 5.0 technology effectively in their future workplaces, thereby increasing their self-efficacy on the technology deployment (Yeoh and Yap, 2024). Besides, Venkatesh and Bala (2008) and Chin, Do, and Kim (2022) mentioned that how useful users think a technology greatly affects their decision to use it. Moreover, when tertiary learners understand the importance of IR 5.0 technologies for their future workplace, they have more expectation on improving their job performance when using the technologies (Yeoh et al., 2023; Yeoh and Yap, 2024). Hence, the following hypotheses are presumed.

$H_{a6:}$ Tertiary learners’ perceived importance of IR 5.0 technologies has significant effect on their self-efficacy to use the technologies.

$H_{a7:}$ Tertiary learners’ perceived importance of IR 5.0 technologies has significant effect on their behavioural intention to use the technologies.

H_{a8}: Tertiary learners' perceived importance of IR 5.0 technologies has significant effect on their job performance expectancy on usage of the technologies.

2.1.4 Effect of Tertiary Learners' Behavioural Intention to Use IR 5.0 Technologies on Adaptation of the Technologies in Their Future Workplaces.

Venkatesh et al. (2003) found that there is a positive relationship between users' behavioral intention to use a technology and their adaptation to the technology. In other words, when users have a strong intention to adopt a technology, they are more likely to proceed to use it. Chen (2011) also reveals that users who demonstrate a higher intention to use a technology are more inclined to embrace and utilize it effectively. Yeoh and Yap (2024) further reaffirm that the tertiary learners' behavioural intention to use a new technology significantly impacts their adaptation to the technology. In line with these research findings, the following hypothesis has been established.

H_{a9}: Tertiary learners' behavioural intention to use IR 5.0 technologies has significant effect on their adaptation of the technologies in their future workplaces.

2.1.5 Effect of Tertiary Learners' Behavioural Intention to Use IR 5.0 Technologies on Their Self-Efficacy to Use the Technologies.

According to the research of Yeoh et al. (2023), tertiary learners' behavioural intention to use IR 4.0 technologies has significant impact on their self-efficacy to adapt the technologies. When learners are committed to use a technology, they are more likely to invest time in learning and practicing it. This active engagement enhances their skills and familiarity with the technology, thereby boosts their confidence and ability to use it. As a result of these insights, the following hypothesis is proposed.

$H_{a10:}$ Tertiary learners' behavioural intention to use IR 5.0 technologies has significant effect on their self-efficacy to use the technologies.

2.1.6 Effect of Tertiary Learners' Technological Job Performance Expectancy on Their Adaptation of IR 5.0 Technologies in Their Future Workplaces.

According to Sang (2018), an individual's job performance expectancy has a direct impact on the adaptation to new technologies. If learners believe that adopting a technology will enhance their job efficiency and effectiveness, they are more likely to actively engage with and integrate them into their work practices (Venkatesh et al., 2003; Chen , 2011; Yeoh and Yap, 2024). This anticipation of better performance outcomes motivates learners to prepare and adapt to emerging technologies in their future careers. Consequently, the following hypothesis has been developed.

$H_{a11:}$ Tertiary learners' technological job performance expectancy has significant effect on their adaptation of IR 5.0 technologies in their future workplaces.

2.1.7 Effect of Tertiary Learner's Technological Job Performance Expectancy on Their Self-Efficacy and Behavioural Intention to Use IR 5.0 Technologies.

Williams (2010) and Latip et al. (2020) found out that individuals' expectations about the outcomes of using a technology significantly impact their self-efficacy to use the technology. When users anticipate that a technology improves their job performance, they are more likely to feel confident in their ability to use it (Yeoh et al., 2023). This positive expectation boosts their self-efficacy, as they believe that mastering the technology will lead to better job outcomes. Additionally, Yeoh and Yap (2024) found that tertiary learners' job performance expectancy notably affects their behavioural intention to use AI technologies. Learners who anticipate that a technology will yield better career outcomes, such as increased efficiency and productivity, are more motivated to adopt and utilize it. Hence, the following hypotheses have been constructed.

$H_{a12:}$ Tertiary learners' job performance expectancy on the usage of IR 5.0 technologies has significant effect on their self-efficacy to use the technologies.
$H_{a13:}$ Tertiary learners' job performance expectancy on the usage of IR 5.0 technologies has significant effect on their behavioural intention to use the technologies.

2.1.8 Effect of Tertiary Learner's Technological Knowledge Base on Adaptation of IR 5.0 Technologies in Their Future Workplaces.

According to Razali et al. (2021), students' readiness to adapt IR 4.0 technologies is influenced by their level of technological knowledge base. When tertiary learners have a solid understanding of a technology, they find it easier to understand and use the technology. As a result, users are more comfortable and confident to leverage a new technology in their future careers (Ngoc et al., 2022). Hence, the following hypothesis has been proposed.

H_{a14}: Tertiary learners' technological knowledge base has significant effect on their adaptation of IR 5.0 technologies in their future workplaces.

2.1.9 Effect of Tertiary Learner's Technological Knowledge Base on Job Performance Expectancy on the Usage of IR 5.0 Technologies.

When learners are well-versed in technology, they are more confident that they can leverage the technology to improve their job performance (Cichoń et al., 2021). This confidence leads them to expect better outcomes, such as increased efficiency and productivity in their careers. In essence, a solid technological foundation enhances users' expectations of improved job performance by enabling them to see how technology can positively impact their work performance. Consequently, the following hypothesis is developed.

H_{a15}: Tertiary learners' technological knowledge base has significant effect on their job performance expectancy when using IR 5.0 technologies.

2.1.10 Mediating Effect of Tertiary Learners' Perceived Importance on The Relationship Between Perceived Ease of Use and Behavioural Intention to Use IR 5.0 Technologies.

According to the Technology Acceptance Model (TAM), the influence of tertiary learners' perceptions on how easy a technology is to be used on their intention to use the technology is mediated by their perception of its importance (Venkatesh and Davis, 2000; Venkatesh and Bala, 2008). Tertiary learners are expected to use IR 5.0 technologies if they find it user-friendly. Additionally, their intention to use IR 5.0 technologies is stronger if they also see these technologies are valuable or essential to meet their needs. Thus, the following hypothesis is presumed.

H_{a16}: The relationship between perceived ease of use and behavioural intention to use IR 5.0 technologies in future workplaces is mediated by their perceived importance on these technologies.

2.2 Self Performance-Related Variables for Tertiary Learners' Adaptation of IR 5.0 Technologies.

This section analyzes the inter-relationships among self performance-related determinants, namely life-long learning tendency, critical thinking, collaboration, communication, creativity, and problem-solving skills as well as their impacts on tertiary learners' adaptation of IR 5.0 technologies. These insights are then used to formulate relevant hypotheses in this section.

2.2.1 Effect of Tertiary Learners' Life-Long Learning Tendency on Their Adaptation of IR 5.0 Technologies At Their Future Workplaces.

According to Poquet and Laat (2021), life-long learning affect one's development in the AI era as his/her commitment to continuous learning helps her/him to stay up-to-date with evolving technologies over times. Learners who prioritize lifelong learning are more open to acquire new skills and knowledge. As a result of it, they are more adaptable and proficient with emerging technological tools and systems. This ongoing learning mindset facilitates learners' effective usage and integration of IR 5.0 technologies in their future careers. In line with this development, the following hypothesis has been constructed.

$H_{a17:}$ Tertiary learners' life-long learning tendency have significant effect on their adaptation of IR 5.0 technologies in their future workplaces.

2.2.2 Effect of Tertiary Learners' Life-Long Learning Tendency on Their Critical Thinking, Communication, Collaboration, Creativity and Problem-Solving Skills.

Engaging in lifelong learning helps learners to find new information, consider different viewpoints, and address complex problems. This effort improves their critical thinking and problem-solving abilities (Bilgic, Cam, and Hamutoglu, 2021). It also boosts their communication skills by learning how to present the opinions and ideas effectively. Additionally, life-long learning encourages creativity by promoting experimentation and new ideas that leads to better work performance (Sahlberg, 2009). Thus, the following hypotheses have been formulated.

$H_{a18:}$ Tertiary learners' life-long learning tendency have significant effect on their critical thinking skills.

$H_{a19:}$ Tertiary learners' life-long learning tendency have significant effect on their communication skills.

$H_{a20:}$ Tertiary learners' life-long learning tendency have significant effect on their creativity skills.

$H_{a21:}$ Tertiary learners' life-long learning tendency have significant effect on their problem-solving skills.

2.2.3 Effect of Tertiary Learners' Critical Thinking Skills on Their Adaptation of IR 5.0 Technologies in Their Future Workplaces.

According to Gökçearslan, Solmaz, and Karabulut (2019), critical thinking skills are essential for effective usage of advanced technologies. Critical thinking skills enable users to analyze, evaluate, and address complex challenges when they adapt IR 5.0 technologies. As a result, users' strong critical thinking skills enhance their ability to adapt to and thrive with emerging technologies in their future careers. Based on these insights, the following hypothesis has been initiated.

$H_{a22:}$ Tertiary learners' critical thinking skills have significant effect on their adaptation of IR 5.0 technologies in their future workplaces.

2.2.4 Effect of Tertiary Learners' Critical Thinking Skills on Their Collaboration Skills.

According to Styron (2014), learners who are good at critical thinking can more effectively assess and understand different viewpoints. This ability helps them to lead meaningful discussions and solve problems within a group. Being a critical thinker, he/she can communicate clearly, find solutions through negotiation, and work better with others. Thus, the following hypothesis is constructed.

$H_{a23:}$ Tertiary learners' critical thinking skills have significant effect on their collaboration skills.

2.2.5 Effect of Tertiary Learners' Communication Skills on Their Adaptation of IR 5.0 Technologies in Their Future Workplaces.

Colussi et al. (2022) assert that communication skills greatly influence the use of digital technologies. Additionally, Maican (2019) suggest that effective communication is crucial for the efficient sharing and utilization of resources, leading to savings in both time and cost. Besides, strong communication skills help learners articulate and exchange ideas clearly, pose pertinent questions, and work collaboratively, which is vital for successful adaptation of advanced technologies in their work processes (Gilakjani, 2017). In line with these arguments, the following hypothesis has been constructed.

$H_{a24:}$ Tertiary learners' communication skills have significant effect on their adaptation of IR 5.0 technologies in future workplace.

2.2.6 Effect of Tertiary Learners' Communication Skills on Their Problem-Solving Skills.

Belousov, Burmistrov, and Ternov (2020) highlighted that strong communication skills are essential for effective problem-solving. This is because effective communication is key to accurately identifying and understanding problems, as well as to discussing and sharing potential solutions. For instance, individuals who communicate well can clearly express their ideas, ask relevant questions to explore alternative solutions to the problem faced. Hence, the hypothesis is outlined below.

$H_{a25:}$ Tertiary learners' communication skills have significant effect on their problem-solving skills.

2.2.7 Effect of Tertiary Learners' Collaboration Skills on Adaptation of IR 5.0 Technologies in Their Future Workplaces.

Nair and Fahimirad (2019) mentioned that tertiary learners' collaboration skills significantly affect their readiness in adapting new technologies in their future careers. Collaboration skills can enhance tertiary learners' adaptability to IR 5.0 technologies by leveraging diverse expertise from other team members in the technologies' adaptation. When tertiary learners work as a team, they can accelerate learning through exchange of information and experiences among each other. This collaboration process will influence their adaptation to the IR 5.0 technologies in their future workplaces. Thus, the following hypothesis is initiated.

H_{a26}: Tertiary learners' collaboration skills have significant effect on their adaptation of IR 5.0 technologies in future workplace.

2.2.8 Effect of Tertiary Learners' Collaboration Skills on Their Creativity Skills.

According to Nisa et al. (2023), individuals' collaboration skills have impact on their creativity skills. When people work together, sharing different perspectives and brainstorming as a team, it leads to more creative solutions. This exchange of ideas and cooperative effort often leads to more original and imaginative outcomes, thereby boosting their overall creativity. Given these insights, the following hypothesis has been developed.

H_{a27}: Tertiary learners' collaboration skills have significant effect on their creativity skills.

2.2.9 Effect of Tertiary Learners' Creativity Skills on Their Adaptation Of IR 5.0 Technologies in Their Future Workplaces.

Forster (2015) emphasized that creativity is crucial for thriving in the new technological era. Besides, Turner and Mulholland (2017) also noted that creativity is vital for tertiary learners to prepare for future jobs in the IR 4.0 environment. In addition, creativity helps tertiary learners to think of new and innovative ways to use IR 5.0 technology in their future workplace. Based on these arguments, the following hypothesis has been proposed.

$H_{a28:}$ Tertiary learners' creativity skills have significant effect on their adaptation of IR 5.0 technologies in future workplace.

2.2.10 Effect of Tertiary Learners' Problem-Solving Skills on Their Adaptation of IR 5.0 Technologies in Their Future Workplaces.

Researches done by Yeoh et al. (2023), Wilson et al. (2017), Teng et al. (2019), and Majid et al. (2019) show that problem-solving skills play a crucial role in how well tertiary learners adapt to new technologies in the workplace. Effective problem-solving enables learners to address issues, find practical solutions, and apply technologies successfully. This ability helps them to manage the challenges of adapting new technological tools and make the most out of it. This effort leads to better integration and use of IR 5.0 technologies in their future careers. Thus, the following hypothesis has been initiated.

$H_{a29:}$ Tertiary learners' problem-solving skills have significant effect on their adaptation of IR 5.0 technologies in their future workplace.

2.2.11 Effect of Tertiary Learners' Problem-Solving Skills on Their Critical Thinking, Collaboration and Creativity Skills.

Elbyaly and Elfeky (2023) emphasize that one's problem-solving skills significantly enhance his/her critical thinking abilities. When learners are proficient in solving problems, they become better at evaluating information, questioning assumptions, and reasoning cause and effect scenarios. Thus, their critical analysis and decision-making skills are further strengthened. Additionally, Xu, Wang, and Wang (2023) highlighted that collaborative problem-solving skills positively affects learners' interactions with others. Learners with strong problem-solving skills are better at working with others to identify issues, share ideas, and develop solutions. Furthermore, problem-solving skills acquired via related professional trainings significantly boost individuals' creativity (Wang and Horng, 2002). Learners who are competent in problem-solving are more likely to tackle challenges with innovative thinking and experiment new ideas and techniques. These insights lead to the formulation of the following hypothesis.

$H_{a30:}$ Tertiary learners' problem-solving skills have significant effect on their critical thinking skills.

$H_{a31:}$ Tertiary learners' problem-solving skills have significant effect on their collaboration skills.

$H_{a32:}$ Tertiary learners' problem-solving skills have significant effect on their creativity skills.

2.3 Research Theoretical Framework

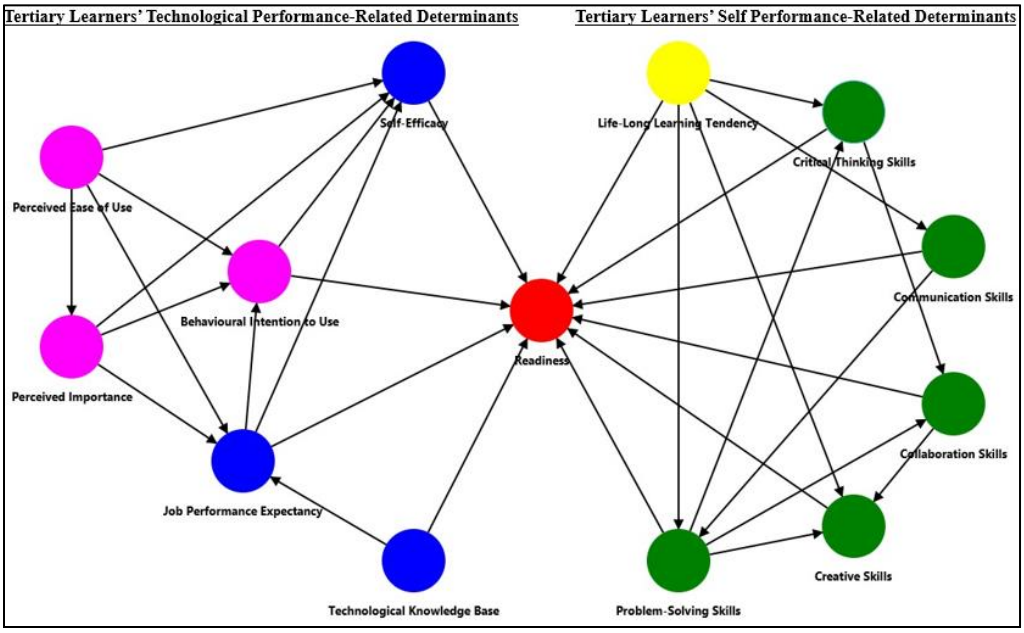

Figure 2.3: The theoretical framework of the research.

The hypotheses constructed are consolidated into the research theoretical framework shown in Figure 2.3. This framework illustrates the various determinants and their interconnections that influence tertiary learners' adaptation of IR 5.0 technologies in their future work environment.

CHAPTER 3

METHODOLOGY

Chapter 3 outlines the research design, defines the target population and sample, describes the deployed sampling method, and explains data collection procedures. An in-depth description on the process of data analysis using Partial Least Squares-Structural Equation Modelling (PLS-SEM) is elaborated at the end of the chapter.

3.1 Introduction

This research aims to identify the performance-related determinants that significantly affect tertiary learners' adaptation to IR 5.0 technologies. Moreover, the study examines the inter-relationships among performance-related determinants to understand their impact on tertiary learner's adaptation of IR 5.0 technologies. The contributing factors are categorized into two groups, namely tertiary learners' technological and self performance-related determinants. Tertiary learners' technological performance-related determinants include their perceived ease of use, perceived importance, behavioural intention to use as well as their technological knowledge base, job performance expectancy and self-efficacy. On the other hand, tertiary learners' self performance-related determinants include their life-long learning tendency, critical thinking, collaboration, communication, creativity, and problem-solving skills.

3.2 Research Design

The research design provides procedures on how to collect, evaluate, and explain the data to answer the problem statements and objectives of the research (Rahi, 2017). Besides, research design serves as a framework that guides researchers to achieve their objectives. This research aims to determine the significant determinants that affects the adoption of IR 5.0 technologies among undergraduates at UTAR Kampar. On top of that, the research seeks to examine the inter-relationships between the performance-related determinants that influence the adaptation to IR 5.0 technologies among the respondents. The target population of the research included all second year and onwards undergraduates across five faculties at UTAR Kampar campus.

The research uses quantitative approach through a survey questionnaire. The question items are all adapted from existing literature. The questionnaire is divided into Section A, B and C. Section A collects demographic information of the respondents, including their gender, faculty, and year of study. Next, Section B addresses the agreement level of the respondents towards the question items related tertiary learners' technological performance-related determinants to adapt IR 5.0 technologies, namely self-efficacy, perceived ease of use, perceived importance, behavioural intention to use and job performance expectancy. In addition, this section also explores tertiary learners' self performance-related determinants to adapt IR 5.0 technologies, specifically their life-long learning tendency and 21st century learning skills. Additionally, the readiness of tertiary learners to adapt IR 5.0 technologies is assessed at the end of this section. The questionnaire is ended at Section C. This section includes frequency-based questions about respondents' perceptions of their technological knowledge base and 21st century learning skills, including critical thinking, communication, collaboration, creativity, and problem-solving skills are measured.

Excluding question items in Section A, the questionnaire deploys a seven-point Likert scale to record responses to question items in the questionnaire. In Section B, an agreement-based Likert scale that comprises range from 1 to 7 which follows the sequence of totally disagree, strongly disagree, disagree, neutral, agree, strongly agree and totally agree. This scale is used to evaluate agreement level of tertiary learners on statements listed for the performance-related determinants analyzed. For Section C, a frequency-based Likert scale is used. The response options range from 1 to 7 indicate the frequency options of never, very rarely, rarely, sometimes, frequently, very frequently and always to measure how often the tertiary learners engage in or evaluate the actions described in the questionnaire.

The questionnaire items have been revised and compiled from the works of past literature by Yeoh et al. (2023), Yeoh and Yap (2024), Schmidt et al. (2009), Chai and Tsai (2011), Chai et al. (2015), IFL (2015), Kang et al. (2010), Petway et al. (2016), Susnea and Vasiliu (2016), Cropley and Knapper (2000), Binkley et al. (2011) and Kirby et al. (2010).

Table 3.2: Summary of Retrieved Questionnaire Items and Corresponding Citations

Determinants	**Sources**
Self-Efficacy Perceived Ease of Use Perceived Importance Behavioural Intention to Use Job Performance Expectancy Technological Knowledge Base	Yeoh et al. (2023), Yeoh and Yap (2024), Schmidt et al. (2009), Chai and Tsai (2011),
Life-Long Learning Tendency	Cropley and Knapper (2000), Kirby et al. (2010)
Critical Thinking Skills Collaboration Skills Communication Skills Creativity Skills Problem-Solving Skills	Yeoh et al. (2023), Yeoh and Yap (2024), Chai et al. (2015), IFL (2015), Kang et al. (2010), Petway et al. (2016), Susnea and Vasiliu (2016), Binkley et al. (2011)

3.3 Population and Sample

This research has targeted all undergraduates who are currently at second year and above in UTAR Kampar campus as the research population. These undergraduates are from five faculties at the university, namely Faculty of Arts and Social Science (FAS), Faculty of Business and Finance (FBF), Faculty of Engineering and Green Technology (FEGT), Faculty of Information and Communication Technology (FICT) and Faculty of Science (FSC). The research focuses on UTAR Kampar Campus due to its diverse range of academic programs offered by all these faculties. It will facilitate the examination of the performance-related determinants among undergraduates across various academic disciplines in relation to adapting IR 5.0 technologies. Second year and onwards undergraduates were selected as the sample for this study since they have been exposed to the courses that involving usage of technologies such as Machine-Learning, Big Data, and IoT. Additionally, these tertiary learners are expected to expose to real-life applications of emerging technologies in their industrial training attachment at various industrial and service business entities in Malaysia.

3.4 Sampling Method and Procedure

Multi-staged cluster sampling technique is used in the research. This method involves sampling in multiple stages, progressively narrowing down from the scope or area in the sample selection (Sedgwick, 2015). Initially, broad clusters are randomly selected. Within these clusters, smaller sub-clusters are then randomly sampled. Finally, individuals are chosen randomly from these selected sub-clusters. This approach effectively manages large populations by progressively narrowing down from broad clusters to specific individuals. This approach improves the representativeness of the sample and provides a more accurate reflection of the population by selecting diverse primary sampling units from different clusters at each stage. Additionally, conducting the research by using multi-staged cluster sampling technique is cost and time effective (Ahmed et al., 2017).

The target population which are tertiary learners in UTAR Kampar has been divided into five distinct clusters based on their attached faculties. In first stage, a degree program is selected randomly from each of five faculties involved in this study. The lists of degree programs for all faculties are available in UTAR official website. In second stage, within the selected degree program, an undergraduate second or third year course is randomly chosen from the listing of courses offered in June 2024 trimester. In third stage, a lecture time slot for the selected course has been chosen randomly. Then, permission for allowing data collection during the selected course lecture time is requested from the respective lecturers via written emails that are sent them. In final stage, students who attend the selected lecture time slots will be the respondents for this survey. These procedures are repeated for the other four faculties at UTAR Kampar.

3.5 Data Collection Procedure

In the research, data collection from selected samples was carried out using a questionnaire survey via Google Forms. Participants can access the questionnaire via Google Forms link or the QR code that provided.

3.6 Data Analysis Procedure

The research consists a total of 187 respondents. All collected data were exported and saved in an Excel CSV file, which was then imported into SmartPLS 4.0 for further analysis using Partial Least Squares-Structural Equation Modelling (PLS-SEM).

3.6.1 Data Analysis Using Partial Least Squares-Structural Equation Modelling (PLS-SEM)

In this research, Partial Least Squares-Structural Equation Modelling (PLS-SEM) is utilized to analyze data collected from the research fieldwork. PLS-SEM is used due to its relatively less demand of sample sizes. It is an appropriate data analysis methodology for exploratory studies with limited data availability from the target population (Yeoh et al., 2023). Besides, PLS-SEM is highly flexible in allowing researchers to model complex relationships and interactions among numerous latent constructs in the research theoretical framework (Anderson and Gerbing, 1988; Urbanch and Ahleman, 2010). Moreover, PLS-SEM does not require assumption of normal distribution for data collected (Hair et al.,2019). In addition, PLS-SEM uses an iterative bootstrapping techniques to estimate the scores for latent constructs and the strength of relationships among latent constructs in the research model analyzed. It aims to maximize how well the model prediction and explanation of variability in the responses in an endogenous construct by its exogenous constructs (Dash and Paul, 2021). In this study, PLS-SEM is chosen instead of Covariance-Based Structural Equation Modelling (CB-SEM) due to its focus on causal relationships and predictive relevancy among constructs in development and prediction in the research theoretical framework established (Hair et al., 2019; Dash and Paul, 2021).

3.6.2 Evaluation of PLS-SEM

The model evaluation using PLS-SEM is typically divided into two key stages, namely measurement and structural model analysis. In the measurement model analysis, PLS-SEM examines how well the observed indicators represent each latent construct in the research model. Furthermore, PLS-SEM evaluates the consistency and reliability of constructs' indicators to ensure that the latent constructs are measured accurately by its related indicators. It also assesses both convergent and discriminant validity of the constructs by their respective indicators. If all criteria in the measurement model analysis are fulfilled, the evaluation progresses to structural model analysis. In this stage, the significance of relationships among constructs in the research theoretical framework are statistically analyzed using bootstrapping technique (Hair et al., 2019).

3.6.2.1 Reflective Measurement Model Analysis

Firstly, the loadings of indicators from each of latent construct in the research theoretical model are evaluated. The loading indicates the strength of the relationship between an indicator and its latent construct. To ensure items' reliability, indicator loadings are preferably to be above 0.708. In other words, at least 50% of the variation of responses in the indicator is explained by its attached latent construct (Hair et al., 2019).

Secondly, the theoretical model's internal consistency and reliability of constructs by their respective indicators are evaluated by computed Cronbach's alpha. It evaluates how well the indicators are coupled together to reflect the underlying construct. Higher value of Cronbach's alpha value for each construct indicates the indicators of the construct have a high degree of internal consistency and reliability. However, Cronbach's alpha is considered less accurate for reliability evaluation because it treats all items as equally important and does not account for differences in the importance or weight of individual items. To mitigate this limitation, Dijkstra-Henseler's rho (ρA) value is calculated. This measure incorporates item weights and provides a reliability value that falls between Cronbach's alpha and composite reliability. It offers a more precise assessment of internal consistency of indicators in each latent construct. For satisfactory internal reliability, all constructs' composite reliability and Dijkstra-Henseler's rho (ρA) values are to be above 0.7 (Hair et al., 2019).

Lastly, the convergent validity of latent constructs is assessed by computing their Average Variance Extracted (AVE). For each construct, the AVE values should exceed 0.5 that indicates that the construct explains 50% and above of the variation of responses in its indicators. Additionally, Fornell-Larcker criterion is deployed to evaluate discriminant validity among constructs in the research model by comparing the AVE values of each construct with the squared correlation coefficients between that construct and other constructs. This criterion ensures that each construct is more strongly related to its own indicators than that are other constructs. In other words, it is used to justify each construct is unique and distinct from other constructs in the research model. Specifically, the AVE values for each construct should be greater than the highest squared correlation between the construct and any other constructs (Hair et al., 2019).

3.6.2.2 Structural Model Analysis

The Variance Inflation Factor (VIF) is evaluated to ensure that the relationships between exogenous constructs and endogenous constructs in the research model are not distorted by multicollinearity problem. The VIF values assess the extent to which multicollinearity increases the variance of an estimated regression coefficient. Ideally, VIF values of constructs should fall in the range from 1 to 5. The VIF values that exceeds 5 would indicates a significant multicollinearity problem among exogenous constructs that are related to an endogenous construct in the research model (Hair et al., 2019).

Besides, bootstrapping method is utilized in PLS-SEM to analyse the statistical significance of the estimates for parameters in the relationships among constructs in the research theoretical framework. As bootstrapping method is used, the analyzed results does not rely on the assumption of multivariate normal distribution of data collected. One-sided significance level of 0.05 is used to construct bootstrapping confidence intervals. When zero is within the confidence interval, it indicates that the relationship is not statistically significant at the 0.05 significance level. Furthermore, significant coefficients show a strong relationships between the constructs. The significant path coefficients are identified by computing their t-values and p-values. On top of that, if the computed t-statistic exceeds 1.96, the p-value will be less than 0.05. The result indicates that there is a significant effect of the exogenous construct on the endogenous construct at 0.05 significant level (Hair et al., 2019).

Furthermore, the Coefficient of Determination (R^2) is used to measures the proportion of the variance in the dependent constructs that is predictable by their independent constructs within the research model. A higher R^2 value indicates a large proportion of the variance in the endogenous constructs is explained by their exogenous constructs. Specifically, R^2 values of 0.25, 0.50, and 0.75

represent weak, moderate, and substantial explanatory power of the exogenous constructs of endogenous constructs respectively. Additionally, Cross-Validated Predictive Power (Q^2) values evaluate the predictive relevance of the research model. It reflects how well the research model can predict new or unseen data. Q^2 values that are greater than 0 indicates that the model has predictive relevance. With higher Q^2 values, it reflects a better predictive capability of the research framework (Hair et al., 2019).

Then, the PLS Predict method is deployed to assess the predictive performance of the research model. This method does not rely on specific data distribution assumptions. This advantage makes it versatile for various models and datasets. It uses a k-fold cross-validation process to determine how effectively the model can be used to generalize to new data set. The predictive accuracy of the endogenous constructs in the research model is evaluated through the calculation of the Root Mean Square Error (RMSE). On the other hand, the Linear Model (LM) component of PLS-SEM focuses on analyzing the relationships between variables based on the structural model. The model's RMSE values are compared against the LM benchmark values. If the RMSE for a dependent construct indicator is lower than that of the naïve LM benchmark, it indicates that the model demonstrates strong predictive power (Hair et al., 2019).

Lastly, the Value Accounted For (VAF) is computed to evaluate the strength of the mediating effects within the model. It quantifies the proportion of the total effect of an independent construct on a dependent construct that is mediated through one or more intervening constructs. Additionally, VAF helps determine whether the relationship between an exogenous construct and an endogenous construct is direct or partially mediated through other constructs. If the indirect effect is found to be statistically significant, it confirms that mediation exists within the structural research model. To assess the extent of this mediation, the VAF is calculated by dividing the indirect effect by the total effect. A VAF value that less than 0.2, 0.2 to 0.8 and greater than 0.8 signifies no mediation, partial mediation, and full mediation in the structural model (Abdullahi, Raman, and Solarin, 2022).

CHAPTER 4

RESULTS AND DISCUSSION

Chapter 4 provides an overview of the respondents' demographic details, findings of research and discussion on these research results.

4.1 Descriptive Statistics

Table 4.1: Respondents' demographic information

Respondent's Profile	Categories	Frequency	Percentage
Gender	Male	79	42.25
	Female	108	57.75
Faculty	FAS	36	19.25
	FBF	55	29.41
	FEGT	24	12.83
	FICT	39	20.86
	FSC	33	17.65
Year of Study	2	94	50.27
	3 and above	93	49.73

In the fieldwork conducted for the research, there were 187 respondents in total. Referring to Table 4.1, 79 (42.25%) of participants in the research fieldwork were male, while the rest were female. For the sampling distribution of respondents with respect to their attached faculties, 19.25% (36), 29.41% (55), 12.83% (24), 20.86% (39) and 17.65% (33) of them were from Faculty Arts and Social Science (FAS), Faculty of Business and Finance (FBF), Faculty of Engineering and Green Technology (FEGT), Faculty of Information and Communication Technology (FICT) and Faculty of Science (FSC) respectively. For the year of study, 94 (50.27%) of respondents were in their second year as 93 (49.73%) respondents were in their third year or beyond.

4.2 Evaluation on Research Reflective Measurement Model

As shown in the Table 4.2.1 and Table 4.2.2 above, all of the indicators in the research theoretical model are reliable measurements of their corresponding latent constructs as their loading values are above 0.708, with the exception of an indicator (LL8) in the life-long learning tendency construct's that has loading value of 0.656. It is further justified by composite reliability, Cronbach's alpha, and Dijkstra-Henseler's rho (ρA) values of the latent constructs that are all above 0.70. All of the latent constructs' Average Variance Extracted (AVE) values are more than 0.50, which indicates that the latent constructs' convergent validity is justified as the indicators are well aligned with their respective constructs in the research model.

Table 4.2.1: Indicators' loadings and constructs' internal reliability. - Tertiary Learners' Technological Performance-Related Determinants

Construct	Loading	Cronbach's Alpha	ρA	CRI	AVE
Self-Efficacy (SE)		0.890	0.896	0.924	0.753
SE1: I am **confident about my ability** to adopt 5th Industry Revolution Technologies in my future career.	0.891*				
SE2: I am **on the top of things** (in full control) when I adopt 5th Industry Revolution Technologies in my future career.	0.847*				
SE3: Things are **going on the way I want** to when I adopt 5th Industry Revolution Technologies in my future career.	0.838*				
SE4: I can adopt 5th Industry Revolution Technologies **effectively** in my future career.	0.893*				
Perceived Ease of Use (PEU)		0.713	0.775	0.871	0.772
PEU1: As an end user, I find it is **easy to use** 5th Industry Revolution Technologies to do what I want it to do.	0.922*				
PEU2: As the end user, I believe interacting with 5th Industry Revolution Technologies **does not require a lot of my mental effort**.	0.833*				

Table 4.2.1 continued: Indicators' loadings and constructs' internal reliability. - Tertiary Learners' Technological Performance-Related Determinants

Construct	Loading	Cronbach's Alpha	ρA	CRI	AVE
Perceived Importance (PI)		0.911	0.914	0.944	0.849
PI1: I **believe** 5th Industry Revolution Technologies are **useful** to support my future career.	0.939*				
PI2: I **believe** 5th Industry Revolution Technologies are **valuable** to support my future career.	0.941*				
PI3: I **believe** 5th Industry Revolution Technologies are **important** to support my future career.	0.885*				
Behavioural Intention to Use (BIU)		0.866	0.871	0.918	0.789
BIU1: I **intend** to adopt 5th Industry Revolution Technologies in my future career.	0.915*				
BIU2: I **predict** I would adopt 5th Industry Revolution Technologies in my future career.	0.896*				
BIU3: I **plan** to adopt 5th Industry Revolution Technologies in my future career.	0.853*				

Table 4.2.1 continued: Indicators' loadings and constructs' internal reliability. - Tertiary Learners' Technological Performance-Related Determinants

Construct	Loading	Cronbach's Alpha	ρA	CRI	AVE
Job Performance Expectancy (JPE)		0.878	0.883	0.911	0.674
JPE1: By adopting 5th Industry Revolution Technologies, I expect to **perform better** in my future career.	0.842*				
JPE2: By adopting 5th Industry Revolution Technologies, I expect to get **better job remunerations** (pay, bonus, promotion, compliment, recognition) in my future career.	0.852*				
JPE3: By adopting 5th Industry Revolution Technologies, I expect to **improve time and effort efficiency** in my future career.	0.871*				
JPE4: I expect to find **more job opportunities** for my personal growth and development in the 5th Industry Revolution era.	0.778*				
JPE5: I expect **job market requirements** are **ever-changing** in the 5th Industry Revolution era.	0.754*				

Table 4.2.1 continued: Indicators' loadings and constructs' internal reliability. - Tertiary Learners' Technological Performance-Related Determinants

Construct	Loading	Cronbach's Alpha	ρA	CRI	AVE
Technological Knowledge Base (TKB)		0.913	0.917	0.935	0.743
TKB1: I **develop the technological skills needed** in adopting 5th Industry Revolution technologies over times.	0.816*				
TKB2: I **update knowledge** of 5th Industry Revolution Technologies over times.	0.904*				
TKB3: I **use various ways and strategies** to enhance my understanding of 5th Industry Revolution Technologies over times.	0.909*				
TKB4: I **follow future developments and technologies** of 5th Industry Revolution over times.	0.856*				
TKB5: I access **up-to-date resources** (ex, books, journals) of the 5th Industry Revolution technologies over times.	0.820*				
Readiness to Adapt Fifth Industry Revolution Technologies (R)		0.844	0.844	0.906	0.762
R1: I am able to **adapt the applications** of 5th Industry Revolution technologies in my future career.	0.870*				

Table 4.2.1 continued: Indicators' loadings and constructs' internal reliability. - Tertiary Learners' Technological Performance-Related Determinants

Construct	Loading	Cronbach's Alpha	ρA	CRI	AVE
R2: I am **comfortable** to adapt 5th Industry Revolution technologies in my future career.	0.882*				
R3: I am **prepared** for my future career in Industry Revolution 5.0 era.	0.867*				

Notes: * For $n = 5000, p\ value < 0.05$; ρ_A = Dijkstra-Henseler's rho; CRI= Composite Reliability Index; AVE= Average Variance Extracted.

Table 4.2.2: Indicators' loadings and constructs' internal reliability. - Tertiary Learners' Self performance-related Determinants

Construct	Loading	Cronbach's Alpha	ρA	CRI	AVE
Life-long Learning Tendency (LL)		0.916	0.918	0.931	0.600
LL1: I feel that I am **better to evaluate my success as a learner** than others.	0.776*				
LL2: It is my responsibility to **make sense of what I learn** all the times.	0.787*				
LL3: I **plan learning** by myself.	0.772*				
LL4: I **think about how to improve my own learning** over times.	0.818*				

Table 4.2.2 continued: Indicators' loadings and constructs' internal reliability. - Tertiary Learners' Self performance-related Determinants

Construct	Loading	Cronbach's Alpha	ρA	CRI	AVE
LL5: I **love learning for my betterment** over times.	0.862*				
LL6: I like to **learn by asking and answering** questions.	0.753*				
LL7: I **deal with the unexpected problems** and solve them as they arise.	0.806*				
LL8: I feel **comfortable to deal with uncertainty** over times.	0.656*				
LL9: When I learn something new, I try to **focus on the details** rather than on the 'big picture'.	0.722*				
Critical Thinking Skills (CTS)		0.900	0.903	0.923	0.666
CTS1: I **open for ideas** that challenge my held beliefs.	0.760*				
CTS2: I **consider** various **arguments** to formulate my own point of view.	0.832*				
CTS3: I **justify** my choices/ points of view made.	0.813*				
CTS4: I **filter** the most important **points** from discussions.	0.829*				

Table 4.2.2 continued: Indicators' loadings and constructs' internal reliability. - Tertiary Learners' Self performance-related Determinants

Construct	Loading	Cronbach's Alpha	ρA	CRI	AVE
CTS5: I **suggest new** related **points / ideas / inputs** to the discussion.	0.823*				
CTS6: I put the discussion into **a new perspective.**	0.835*				
Communication Skills (CommS)		0.900	0.902	0.926	0.714
CommS1: I **express my idea clearly** to others.	0.824*				
CommS2: I **get what I want from interactions** with people.	0.837*				
CommS3: I **acknowledge the message** raised during a discussion.	0.851*				
CommS4: I **make appropriate comments** in a discussion.	0.873*				
CommS5: I can **explain** my opinions and decisions.	0.838*				
Collaboration Skills (CollS)		0.903	0.907	0.928	0.720
CollS1: I complete an assigned task via **team effort.**	0.802*				
CollS2: I ensure **each team member** has his/her **contribution** to the assigned task.	0.883*				

Table 4.2.2 continued: Indicators' loadings and constructs' internal reliability. - Tertiary Learners' Self performance-related Determinants

Construct	Loading	Cronbach's Alpha	ρA	CRI	AVE
CollS3: I **share resources, information and work-related knowledge** among team members in completing the assigned task.	0.845*				
CollS4: I **coordinate** with team members to achieve a **common goal.**	0.870*				
CollS5: I make **decision** in an assigned task with **mutual respect** among team members involved.	0.842*				
<u>Creativity Skills (CreaS)</u>		0.864	0.873	0.907	0.710
CreaS1: I **imagine** things that do not yet exist.	0.780*				
CreaS2: I **evaluate the usability** of my **generated ideas.**	0.842*				
CreaS3: I give a **creativity turn** / improvement to **existing processes** that I encounter.	0.885*				
CreaS4: I **generate innovative ideas** in my area of study.	0.860*				

Table 4.2.2 continued: Indicators' loadings and constructs' internal reliability. - Tertiary Learners' Self performance-related Determinants

Construct	Loading	Cronbach's Alpha	ρA	CRI	AVE
Problem-Solving Skills (PSS)		0.903	0.903	0.928	0.720
PSS1: I manage to **solve most problems** even though initially no solution is immediately apparent / known.					
PSS2: When I am aware of a problem, one of the first things I do is to try to **find out exactly what the problem is.**					
PSS3: I **compare alternative solutions/ opinions/ ideas** available.					
PSS4: I **decide and implement the best solution.**					
PSS5: I **evaluate the effectiveness** of the implemented solution to the problem.					
Readiness to Adapt Fifth Industry Revolution Technologies (R)		0.844	0.844	0.906	0.762
R1: I am able to **adapt the applications** of 5th Industry Revolution technologies in my future career.	0.870*				
R2: I am **comfortable** to adapt 5th Industry Revolution technologies in my future career.	0.882*				

Table 4.2.2 continued: Indicators' loadings and constructs' internal reliability. - Tertiary Learners' Self performance-related Determinants

Construct	Loading	Cronbach's Alpha	ρA	CRI	AVE
R3: I am **prepared** for my future career in Industry Revolution 5.0 era.	0.867*				

Notes: * For $n = 5000, p\ value < 0.05$; ρ_A = Dijkstra-Henseler's rho; CRI= Composite Reliability Index; AVE= Average Variance Extracted.

Table 4.2.3: Fornell-Larcker Criterion.

	BIU	CollS	CommS	CreaS	CTS	JPE	LL	PEU	PI	PSS	R	SE	TKB
Behavioural Intention to Use (BIU)	0.888												
Collaboration Skills (CollS)	0.650	0.849											
Communication Skills (CommS)	0.548	0.763	0.845										
Creativity Skills (CreaS)	0.558	0.691	0.663	0.843									
Critical Thinking Skills (CTS)	0.631	0.736	0.758	0.738	0.816								
Job Performance Expectancy (JPE)	0.792	0.639	0.517	0.525	0.607	0.817							
Life-Long Learning (LL)	0.669	0.704	0.706	0.695	0.761	0.696	0.774						
Perceived Ease of Use (PEU)	0.671	0.516	0.540	0.538	0.538	0.560	0.593	0.879					
Perceived Importance (PI)	0.768	0.540	0.436	0.459	0.557	0.757	0.592	0.542	0.922				
Problem-Solving Skills (PSS)	0.619	0.767	0.736	0.771	0.766	0.624	0.751	0.585	0.576	0.849			
Readiness to Adapt 5th Industry Revolution Technologies (R)	0.736	0.608	0.574	0.644	0.624	0.648	0.695	0.671	0.600	0.642	0.873		
Self-Efficacy (SE)	0.643	0.497	0.496	0.552	0.607	0.556	0.620	0.683	0.633	0.634	0.748	0.868	
Technological Knowledge Base (TKB)	0.579	0.483	0.535	0.557	0.581	0.443	0.597	0.623	0.437	0.543	0.710	0.647	0.862

In the study theoretical framework, the Fornell-Larcker criterion compares the average variance extracted (AVE) of each construct with the square of the correlation coefficients among all constructs. According to Table 4.2.3, discriminant or divergent validity among the constructs in the research theoretical framework is supported as the AVE values of each construct are greater than all squared correlation coefficients between the construct and other constructs.

4.3 Structural Model Evaluation

As analysis of requirements on measurement model analysis have been fulfilled, the structural model analysis on the inter-relationships among all the constructs in the research theoretical framework is evaluated,

Table 4.3.1: Variance Inflation Determinant (VIF) values of related constructs.

	BIU	CollS	CommS	CreaS	CTS	JPE	LL	PEU	PI	PSS	R	SE	TKB
Behavioural Intention to Use (BIU)	-	-	-	-	-	-	-	-	-	-	3.590	3.906	-
Collaboration Skills (CollS)	-	-	-	2.671	-	-	-	-	-	-	3.677	-	-
Communication Skills (CommS)	-	-	-	-	-	-	-	-	-	1.991	3.322	-	-
Creativity Skills (CreaS)	-	-	-	-	-	-	-	-	-	-	3.012	-	-
Critical Thinking Skills (CTS)	-	2.416	-	-	-	-	-	-	-	-	3.820	-	-
Job Performance Expectancy (JPE)	2.533	-	-	-	-	-	-	-	-	-	3.323	3.141	-
Life-Long Learning (LL)	-	-	1.000	2.525	2.293	-	-	-	-	1.991	3.666	-	-
Perceived Ease of Use (PEU)	1.530	-	-	-	-	1.917	-	-	1.000	-	-	1.830	-
Perceived Importance (PI)	2.460	-	-	-	-	1.449	-	-	-	-	-	2.859	-
Problem-Solving Skills (PSS)	-	2.416	-	3.087	2.293	-	-	-	-	-	4.247	-	-
Readiness to Adapt 5th Industry Revolution Technologies (R)	-	-	-	-	-	-	-	-	-	-	-	-	-
Self-Efficacy (SE)	-	-	-	-	-	-	-	-	-	-	2.454	-	-
Technological Knowledge Base (TKB)	-	-	-	-	-	1.674	-	-	-	-	2.150	-	-

The Variance Inflation Determinant (VIF) is used to assess collinearity problems among the exogenous constructs in the research framework. According to Table 4.3.1, all VIF values for these constructs range from 1 to 5, indicating that there are no significant collinearity issues among the exogenous constructs in the research model.

Table 4.3.2: p values, t-statistics, 95 percentile bootstrap confidence intervals (CIs) involving tertiary learners' technological performance-related determinants.

Hypothesis	**P value**	**t-statistic**	**95 percentile Bootstrap CI**	**Supported**
H_{a1}: SE→R	0.000	3.900	[0.186, 0.445]	**Yes**
H_{a2}: PEU→SE	0.000	6.433	[0.321,0.547]	**Yes**
H_{a3}: PEU→PI	0.000	8.252	[0.422, 0.639]	**Yes**
H_{a4}: PEU→BIU	0.000	5.121	[0.189, 0.370]	**Yes**
H_{a5}: PEU→JPE	0.002	2.854	[0.078, 0.290]	**Yes**
H_{a6}: PI→SE	0.000	3.372	[0.166, 0.480]	**Yes**
H_{a7}: PI→BIU	0.000	3.654	[0.159, 0.449]	**Yes**
H_{a8}: PI→JPE	0.000	11.856	[0.539, 0.715]	**Yes**
H_{a9}: BIU→R	0.004	2.650	[0.084, 0.359]	**Yes**
H_{a10}: BIU→SE	0.132	1.117	[-0.058, 0.309]	No
H_{a11}: JPE→R	0.111	1.220	[-0.024, 0.224]	No
H_{a12}: JPE→SE	0.310	0.497	[-0.177, 0.088]	No
H_{a13}: JPE→BIU	0.000	4.703	[0.268, 0.540]	**Yes**
H_{a14}: TKB→R	0.001	3.234	[0.124, 0.373]	**Yes**
H_{a15}: TKB→JPE	0.199	0.844	[-0.052 0.143]	No

Table 4.3.3: p values, t-statistics, 95 percentile bootstrap confidence intervals (CIs) involving tertiary learners' self performance-related determinants.

Hypothesis	P value	t-statistic	95 percentile Bootstrap CI	Supported
H_{a17}: LL→ R	0.091	1.333	[-0.031,0.238]	No
H_{a18}: LL→ CTS	0.000	4.895	[0.272, 0.559]	**Yes**
H_{a19}: LL→ CommS	0.000	10.830	[0.570, 0.791]	**Yes**
H_{a20}: LL→ CreaS	0.000	3.441	[0.111, 0.315]	**Yes**
H_{a21}: LL→ PSS	0.000	7.312	[0.352, 0.557]	**Yes**
H_{a22}: CTS→ R	0.051	1.640	[-0.254, -0.002]	No
H_{a23}: CTS→ CollS	0.000	5.192	[0.241, 0.470]	**Yes**
H_{a24}: CommS→ R	0.357	0.366	[-0.097, 0.142]	No
H_{a25}: CommS→ PSS	0.000	6.142	[0.288, 0.510]	**Yes**
H_{a26}: CollS→ R	0.202	0.834	[-0.057, 0.179]	No
H_{a27}: CollS→ CreaS	0.017	2.116	[0.040, 0.312]	**Yes**
H_{a28}: CreaS→ R	0.015	2.179	[0.054, 0.324]	**Yes**
H_{a29}: PSS → R	0.213	0.795	[-0.202, 0.076]	No
H_{a30}: PSS→ CTS	0.000	5.370	[0.314, 0.586]	**Yes**
H_{a31}: PSS→ CollS	0.000	6.611	[0.362, 0.607]	**Yes**
H_{a32}: PSS→ CreaS	0.000	5.153	[0.319, 0.620]	**Yes**

Tables 4.3.2 and 4.3.3 summarize the research findings in relation to tertiary learners' technological and self performance-related determinants respectively. As shown in Table 4.3.2, there is sufficient evidence to conclude that readiness of tertiary learners to adapt IR 5.0 technologies is significantly influenced by

their behavioural intention to use, self-efficacy and technological knowledge base. Besides, tertiary learners' perceived ease of use of IR 5.0 technologies significantly affect their perceived importance, behavioural intention to use, self-efficacy and job performance expectancy on these technologies. Moreover, tertiary learners' perceived importance on IR 5.0 technologies has significant effect on their behavioural intention to use, self-efficacy and job performance expectancy on these technologies. Additionally, tertiary learners' behavioural intention to use IR 5.0 technologies is significantly influenced by their job performance expectancy on these technologies.

By referring Table 4.3.3, there is sufficient evidence to conclude that readiness of tertiary learners to adapt IR 5.0 technologies is significantly influenced by their creativity skills. On top of it, tertiary learners' creativity skills are significantly affected by their collaboration skills. Moreover, tertiary learners' communication skills have significant effect on their problem-solving skills. Besides that, tertiary learners' critical thinking skills is significantly affecting their collaboration skills. Furthermore, tertiary learners' life-long learning tendency is significantly influencing their communication, creativity, critical thinking and problem-solving skills. Finally, tertiary learners' problem-solving skills have a significant effect on their collaboration, creativity and critical thinking skills.

Table 4.3.4: Mediating Effects involving tertiary learners' technological performance-related determinants.

Mediating effect		**Coefficient**	**p-value**	$VAF = \frac{Indirect\ effect}{Total\ effect}$	**Supported**
H_{a16}: The relationship between perceived ease of use and behavioural intention to use is mediated by their perceived importance.					
Direct Effects	PEU → BIU	0.277	0.000***	$VAF = 0.2625$	**Yes**
Indirect Effects	PEU → PI → BIU	0.173	0.001***		
Total Effects	PEU → BIU	0.659	0.000***		

As indicated in Table 4.3.4, the relationship between perceived ease of use and behavioural intention to use to adapt IR 5.0 technologies is partially mediated by their perceived importance on these technologies as the VAF value computed is 26.25%.

Table 4.3.5: R-squared and Q-squared values.

Constructs	R-square	R-square adjusted	Q^2
BIU	0.744	0.741	0.447
CollS	0.641	0.639	0.483
CommS	0.498	0.496	0.480
CreaS	0.637	0.633	0.474
CTS	0.665	0.663	0.568
JPE	0.607	0.603	0.303
PI	0.294	0.291	0.283
PSS	0.649	0.646	0.559
R	0.745	0.736	0.599
SE	0.569	0.563	0.461

The coefficient of determination (R-squared value) quantifies the proportion of variance in an endogenous latent construct that is explained by its exogenous constructs within the research model. Higher R-squared values reflect greater explanatory power of an endogenous constructs by its exogenous constructs in the research model. Based on the researching summarized in Table 4.3.5, 74.4% of variation of tertiary learners' behavioural intention to use IR 5.0 technologies can be explained by their perceived ease of use, perceived importance and job performance expectancy. Moreover, the theoretical framework of the research accounts for 74.5% of the variation in tertiary learners' readiness of adapting IR 5.0 technologies which 25.5% of the variations of it are contributed by other determinants that are not included in this research. These high R-squared values indicate a significant degree of explanatory power of endogenous constructs in the model.

Besides, in tertiary learners' technological performance-related determinants, learners' job performance expectancy, and self-efficacy also have moderate explanatory power by their respective exogenous constructs in the research model as they have R-squared values of 0.607 and 0.569 respectively. Additionally, tertiary learners' perceived importance has a weak explanatory power as it only being explained 29.4% by their perceived ease of use in adapting IR 5.0 technologies.

Furthermore, in the tertiary learners' self performance-related determinants, the critical thinking, collaboration, problem-solving and creativity skills have moderate explanatory power as they have R-squared values of 0.665, 0.641, 0.649, and 0.637 respectively. Moreover, the communication skills of tertiary learners have weak explanatory power as it has R-square values of 0.498.

The Q-squared value assesses the research model's predictive capability for its endogenous latent constructs using data not included in the model's initial sample. By referring to Table 4.3.5, it is shown that all Q-squared values for the endogenous constructs are above 0, indicating that the research model has predictive relevance.

Table 4.3.6: PLS Predict.

Constructs	Q^2 predict	PLS-SEM_RMSE	LM_RMSE
BIU1	0.388	0.800	0.745
BIU2	0.292	0.868	0.819
BIU3	0.361	0.855	0.834
CollS1	0.236	0.854	0.882
CollS2	0.387	0.802	0.862
CollS3	0.274	0.885	0.946
CollS4	0.394	0.768	0.821
CollS5	0.414	0.740	0.759
CommS1	0.294	0.922	0.958
CommS2	0.266	0.876	0.904
CommS3	0.319	0.828	0.886
CommS4	0.386	0.845	0.887
CommS5	0.423	0.772	0.799
CreaS1	0.234	1.005	1.084
CreaS2	0.384	0.759	0.770
CreaS3	0.343	0.799	0.833
CreaS4	0.365	0.843	0.874
CTS1	0.308	0.869	0.871
CTS2	0.305	0.806	0.845
CTS3	0.286	0.772	0.797
CTS4	0.448	0.690	0.704
CTS5	0.471	0.715	0.737
CTS6	0.400	0.811	0.828
JPE1	0.291	0.862	0.827
JPE2	0.126	1.073	1.014
JPE4	0.141	0.984	0.953

Table 4.3.6 continued: PLS Predict.

Constructs	Q^2 predict	PLS-SEM_RMSE	LM_RMSE
JPE5	0.208	0.884	0.810
PI1	0.227	0.949	0.918
PI2	0.277	0.851	0.822
PI3	0.190	0.966	0.968
PSS1	0.353	0.842	0.842
PSS2	0.396	0.709	0.753
PSS3	0.424	0.789	0.815
PSS4	0.418	0.727	0.760
PSS5	0.396	0.780	0.835
R1	0.439	0.742	0.731
R2	0.488	0.729	0.734
R3	0.430	0.853	0.870
SE1	0.369	0.747	0.758
SE2	0.252	0.816	0.819
SE3	0.366	0.739	0.745
SE4	0.370	0.793	0.748

The predictive power of a model can also be evaluated using the PLS Predict approach in SmartPLS 4. Based on Table 4.3.6, it is noticeable that all the values Q-squared predict are greater than zero. This indicates that the model's predictions outperform the most naïve benchmark. Moreover, the root mean square standardized error (RMSE) obtained from PLS is compared with that from a naïve linear regression benchmark (LM). Table 4.3.6 reveals that 31 out of 42 dependent construct indicators have lower RMSE values compared to the naïve benchmarked. Although a minority of dependent construct indicators in the PLS-SEM analysis show higher prediction errors, overall, this indicates that the model possesses medium predictive power.

4.4 Discussion

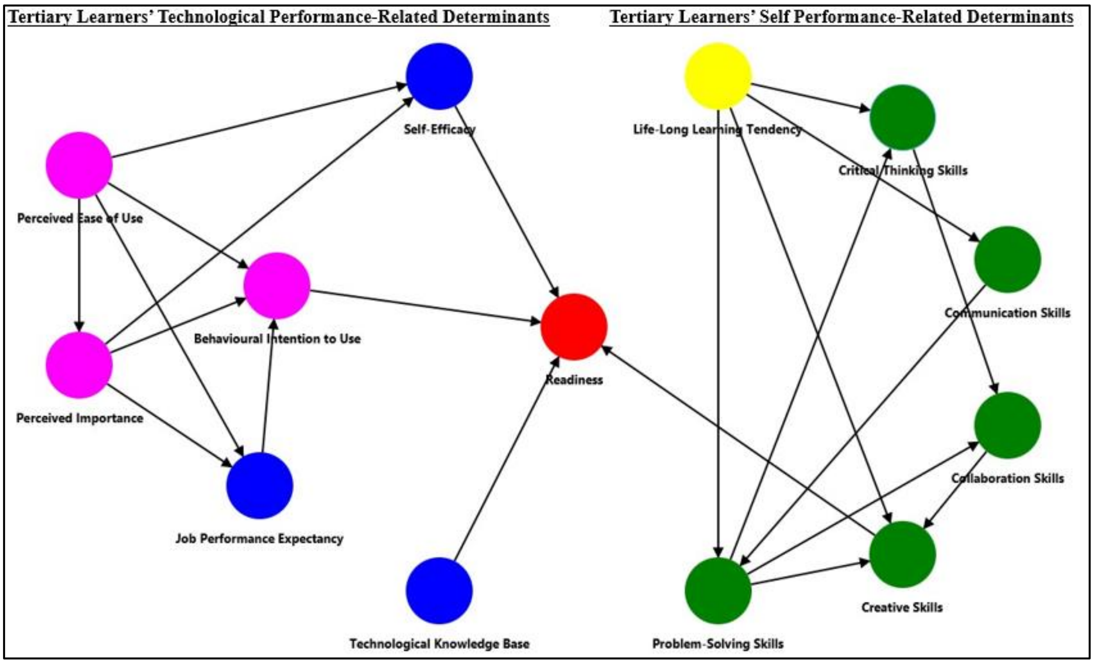

Figure 4.4: Summary of the research results

The key research findings are summarized in Figure 4.4. Among the tertiary learners' technological performance-related determinants, there is sufficient evidence to show that the readiness to adapt IR 5.0 technologies is significantly affected by their self-efficacy, behavioural intention to use and technological knowledge base. These research results are similar with research findings that adaptation level of a technology is directly affected by users' self-efficacy (Yeoh and Yap, 2024; Celik et al.,2013: Renn, 2001; Yeoh et al., 2023; Holden and Rada, 2011), behavioural intention to use the technology (Zwain, 2019; Strzelecki, 2023), and technological knowledge base (Razali et al., 2021; Ngoc et al., 2022). Self-efficacy can enhance tertiary learners' readiness to adapt IR 5.0 technologies. Additionally, a high level of behavioral intention to use these technologies can further increase their readiness to adapt IR 5.0 technologies. Besides, tertiary learners with a strong foundation in technological knowledge are found to be more prepared to adapt IR 5.0 related technologies.

Furthermore, tertiary learners' self-efficacy to use IR 5.0 technologies has enhanced their readiness to adapt the technologies. However, tertiary learners' self-efficacy is significantly affected by both their perceived ease of use and perceived importance on the technologies. These research results are consistent with results from similar researches carried out by Yeoh et al, 2023 and, Yeoh and Yap, 2024. Tertiary learners are more likely to be motivated to adopt technology if they perceive it as valuable, useful and imperative tools to support their future careers. As a result of it, this perception enhances tertiary learners' belief in their ability to effectively use the technology in their future careers. Furthermore, as they perceive a new technology as user-friendly, they are more likely to experience it. Their ability and confidence to adopt IR 5.0 technologies are expected to enhanced over times.

Besides, tertiary learners' behavioural intention to use IR 5.0 technologies is significantly affected by their perceived ease of use, perceived importance and job performance expectancy on these technologies. These research results are aligned with the research findings obtained by Yeoh and Yap (2024), and Yeoh et al. (2023). Additionally, the results that behavioural intention to use is affected by job performance expectancy is consistent with previous similar studies carried out by Raffaghelli et al. (2022), Lee (2022) and Mehta et al. (2019). Tertiary learners will have strong intention to adopt new technologies when they perceive a technology as easy to navigate, beneficial and improve their job performance to their future workplaces.

By reviewing tertiary learners' self performance related determinants, the readiness to adapt IR 5.0 technologies is significantly influenced by their creativity skills. This result consistent with the research finding by Forster (2015), as creativity is crucial for advancing in a new technological era. Individuals with a creativity mindset are able to apply their insights and imagination to innovate and adapt effectively in IR 5.0 era.

Moreover, creative skills of tertiary learners have been significantly affected by their life-long learning tendency, collaboration and problem-solving skills. These results are consistent with the recent research carried out by Kearns (2021). He found out that life-long learning tendency can be further integrated into a creativity learning process, fostering a mindset of continuous improvement and curiosity. In addition to that, life-long learning tendency encourages individuals to explore new areas of interest and refine their creativity skills from times to times. Besides, tertiary learners' collaboration skills have significant effect on their creativity skills (Nisa et al., 2023). Collaborative environments facilitate brainstorming and the sharing of ideas. These efforts can lead to more innovative and effective solutions compared to the solutions that are raised up individually. Furthermore, Adeoye and Jimoh (2023) highlight that problem-solving skills are crucial for enhancing creativity. Effective problem-solving involves generating and evaluating diverse solutions, which supports the development of creativity thinking among learners.

Besides, tertiary learner's life-long learning tendency and communication skills are significantly affecting their problem-solving skills. Lifelong learning is crucial for refining problem-solving techniques, as it continuously develops analytical and critical thinking skills that are essential for effective problem-solving (Bilgic, Cam, and Hamutoglu, 2021). Similarly, Belousov, Burmistrov, and Ternov (2020) emphasized that effective communication skills are a prerequisite for successful problem-solving. Strong communication skills enable individuals to clearly define and articulate problems, facilitate a more precise and effective approach to find solutions to the problem faced.

Lastly, tertiary learner's collaboration skills is significantly affected by both critical thinking and problem-solving skills. This result is consistent with the research conducted by Styron (2014). Critical thinking skills can help learners to analyze and understand knowledge more deeply while problem-solving skills would lead to more effective and innovative outcomes. This deeper understanding on the alternative solutions can further improve the quality of collaboration, as learners are able to bring well-thought-out perspectives and insights to team activities.

CHAPTER 5

CONCLUSION

Chapter 5 summarizes the research findings, elaborate the significance of the research. These results offer valuable insights for UTAR undergraduates into what and how they can adapt IR 5.0 technologies at their future workplaces. Additionally, the research findings serve as terms of reference for the related stakeholders by helping them to enhance tertiary learners' adaptation of IR 5.0 technologies. The chapter concludes with recommendations for both the stakeholders and future research directions.

This study aims to explore tertiary learners' technological and self performance-related factors that significantly impact the adoption of IR 5.0 technologies among tertiary learners. Additionally, it analyzes the inter-relationships among technological performance-related determinants, namely self-efficacy, perceived ease of use, perceived importance, behavioural intention to use, job performance expectancy and technological knowledge base. Simultaneously, the research examines the inter-connections among self performance-related determinants that comprises life-long learning tendency, critical thinking, communication, collaboration, creativity and problem-solving skills.

5.1 Summary on Research Results

From the technological performance-related determinants analyzed, tertiary learners' self-efficacy, behavioural intention to use and technological knowledge base have significant influence on their readiness to adapt IR 5.0 technologies in their future workplaces. Besides, both tertiary learners' self-efficacy and behavioural intention to use IR 5.0 technologies are significantly affected by their perceived importance and ease of use on these technologies. Moreover, tertiary learners' behavioural intention to use IR 5.0 technologies is significantly impacted by their job performance expectancy on these technologies. On top of it, tertiary learners' job performance expectancy is influenced by their perceived ease of use and importance of IR 5.0 technologies. Furthermore, the relationship between perceived ease of use and behavioural intention to use IR 5.0 technologies is partially mediated by their perceived importance of these technologies.

Based on tertiary learners' self performance-related determinants studied, tertiary learners' creativity skills significantly influence their readiness to adapt IR 5.0 technologies. In addition, tertiary learners' creativity skills are significantly affected by their life-long learning tendency, problem-solving and collaboration skills. Besides, life-long learning tendency has significant effect on problem-solving, communications and critical thinking skills among tertiary learners. Moreover, tertiary learners' problem-solving skills directly influence their critical thinking and collaboration skills. Furthermore, tertiary learners' critical thinking skills have significant impact on their collaboration skills in grouped assignment given. Lastly, tertiary learners' communication skills have a significant effect on their problem-solving skills.

5.2 Recommendations to Stakeholders

The research findings provide UTAR Kampar undergraduates with valuable insights into the key essential skills for adapting IR 5.0 technologies in their future workplaces. By recognizing the significance of these determinants, tertiary learners can focus on developing themselves to well prepare for the technologies in the emerging sustainability era. It is recommended that undergraduates can enhance their technological knowledge base and cultivate lifelong learning tendency to strengthen their 21st century skills.

In addition, the findings provide insights of tertiary learners' adaptation on IR 5.0 technologies to management and academic staffs from UTAR Kampar, public and private higher education institutions, Malaysia's Ministry of Higher Education, and international tertiary education providers. These stakeholders can use this research findings as a term of reference to develop policies and guidelines that aim to improve the readiness of tertiary learners towards adaptation of IR 5.0 technologies. For instance, they could implement training programs and establish IR 5.0 related courses to equip undergraduates with the technological knowledge and skills needed to utilize the technologies.

5.3 Recommendations for Future Research

The current research findings are specifically tailored to the undergraduate population at UTAR Kampar campus. To gain a more comprehensive perceptions of tertiary learners in Malaysia, it is advisable to extend the study to include undergraduates from UTAR Sungai Long Campus, as well as other private and public universities in Malaysia.

Additionally, the contributing factors identified in this study are primarily based on existing literatures. As the industry revolution progresses and new technologies emerge, it is important for future research to revisit and expand the technological and self performance-related determinants explored in this study. This ongoing exploration will help ensure that the findings remain relevant and reflective of emerging concepts and advancements in IR 5.0.

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Appendix A

Questionnaire Survey

UNIVERSITI TUNKU ABDUL RAHMAN

<u>QUESTIONNAIRE</u>

TITLE OF THE RESEARCH PROJECT:

Examining performance-related determinants and their inter-relationships in adapting Fifth Industry Revolution (IR 5.0) technologies among UTAR Kampar undergraduates

Dear respondent,

I am Year 3 Semester 3 student of Bachelor of Science (HONS) Statistical Computing and Operations Research from University Tunku Abdul Rahman (UTAR) Kampar. I am currently conducting a survey to examine performance-related variables of UTAR Kampar undergraduates in adapting Fifth Industry Revolution (IR 5.0) technologies.

This questionnaire consists of three sections (Section A to Section C). Your cooperation to answer this questionnaire is indeed helpful for me to complete my research. I appreciate your time in completing these questions. All of the information obtained with regard to this research will be remained private and confidential. The information from this study is solely for academic research purposes. Thank you very much for your time and participation.

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You may access and update your personal data by writing to us at **irene2002@1utar.my.**

Acknowledgment of Notice:

☐ I have been notified by you and that I hereby understood, consented and agreed per UTAR notice.

☐ I disagree. My personal data will not be processed.

Concepts and applications of 5th Industry Revolution Technologies

Dear respondent, please read through the following details to understand the concepts and applications of 5th Industry Revolution related technologies.

Human-Machine Interaction and Smart Cell Industries:

5th Industrial Revolution involves seamless **collaboration between humans and robots** to enhance the productivity and safety. Throughout the collaboration, humans provide creativity while robots provide precision. For Example, **Collaborative Robots (Cobots)** work alongside humans in interconnected smart factories for efficient and flexible production. These technologically advanced machines are designed to be user-friendly and provide physical assistance in performing dangerous tasks. With the introduction of cobots, tasks involving risky work environment will be taken over by them over the times.

Mass Customization & Mass Personalization:

5th Industrial Revolution technologies manage to achieve widespread customization to meet various requirements from wide range of customers. The 5th Industrial Revolution focuses on **eliminating inefficiencies in processes and establishing adaptable, robust systems**. It emphasizes **lean manufacturing** to tailor products and achieve mass customization by removing non-value-added waste. This lean production approach enables manufacturers to meet diverse customer requirements efficiently. For instance, traditional **3D printing** used to require lengthy setup times for customizing products. In the Fifth Industrial Revolution, 3D printing for mass customization can store printing programs. Customers can choose their preferred design, and a printer can produce the desired object, potentially at the point of use. This streamlined process significantly reduces the time needed for design, allowing for the rapid production of large volumes of customized products in just a few hours or less. Additionally, mass personalization is widely implemented in e-commerce platform, where it generates recommendations and promotions based on mass customers' recent searches.

Green Technology and Sustainable Resources:

5th Industrial Revolution technologies are friendly to our nature and biodiversity. Green technology is expected to be matured and widely being used to achieve this aim. Companies and manufacturers would focus on **sustainable practices and eco-friendly manufacturing** to reduce environmental impact. For example, the development of **biofuels** that produce zero greenhouse gas emission while a wide range of biochemicals is being used to replace fossil-based chemicals in many products.

Integration of cyber-physical systems:

Cyber-physical systems integrate digital and physical systems to perform precise tasks in fields like medicine, enhancing the automation and control of healthcare technologies. In the Fifth Industrial Revolution, smart devices are set to be replaced by brain-computer interfaces, allowing direct communication between machines and the human brain. For instance, **Neuralink**, founded by Elon Musk, implants brain chips to help in treating Parkinson's disease and spinal cord injuries, enabling individuals to control devices through mind thinking. Similarly, Kernel, founded by Bryan Johnson, decodes brain activity to recognize speech and music heard by the user. These innovations simplify device control and significantly boost efficiency.

Advanced AI technologies:

In 5th Industrial Revolution, machines will gradually replace many human tasks. Unlike current AI systems that rely on human inputs for algorithm training, advanced AI technologies will autonomously learn from real-time data and developing knowledge without human guidance and training.

For example, in healthcare, autonomous technologies will collect and analyze real-time data using self-improving algorithms. Humanoids, once limited in function, will become versatile tools for diverse tasks. Similarly, **Chatbots** equipped with natural language processing (NLP) now emulate customer service representatives' conversational styles. They handle varied inputs and answer complex questions, self-correcting based on customer feedback to continually improve and enhance customers' satisfaction.

Questionnaire

Section A: Demographic Information.

1. Gender:

☐ Male ☐ Female

2. Faculty:

☐ FSC ☐ FBF ☐ FICT ☐ FEGT ☐ FAS

3. Year of Study:

☐ Year 1 ☐ Year 2 ☐ Year 3 ☐ Year 4 and above

Section B:

Please choose the number (7, 6, 5, 4, 3, 2 or 1) that best describes your perception on each of statements given below.

Number	***Descriptor***
7	Totally Agree
6	Very Agree
5	Agree
4	Neutral
3	Disagree
2	Very Disagree
1	Totally Disagree

Self-efficacy		**Totally Agree---------Totally Disagree**						
1.	I am **confident about my ability** to adopt 5th Industry Revolution Technologies in my future career.	7	6	5	4	3	2	1
2.	I am **on the top of things** (in full control) when I adopt 5th Industry Revolution Technologies in my future career.	7	6	5	4	3	2	1
3.	Things are **going on the way I want** to when I adopt 5th Industry Revolution Technologies in my future career.	7	6	5	4	3	2	1
4.	I can adopt 5th Industry Revolution Technologies **effectively** in my future career.	7	6	5	4	3	2	1
Self-Adaptation of IR 5.0 Technologies		**Totally Agree--------- Totally Disagree**						
1.	I **believe** 5th Industry Revolution Technologies are **useful** to support my future career.	7	6	5	4	3	2	1
2.	I **believe** 5th Industry Revolution Technologies are **valuable** to support my future career.	7	6	5	4	3	2	1
3.	I **believe** 5th Industry Revolution Technologies are **important** to support my future career.	7	6	5	4	3	2	1
4.	I **intend** to adopt 5th Industry Revolution Technologies in my future career.	7	6	5	4	3	2	1
5.	I **predict** I would adopt 5th Industry Revolution Technologies in my future career.	7	6	5	4	3	2	1
6.	I **plan** to adopt 5th Industry	7	6	5	4	3	2	1

	Revolution Technologies in my future career.							
7.	As an end user, I find it is **easy to use** 5th Industry Revolution Technologies to do what I want it to do.	7	6	5	4	3	2	1
8.	As the end user, I believe interacting with 5th Industry Revolution Technologies **does not require a lot of my mental effort**.	7	6	5	4	3	2	1
Job Performance Expectancy		**Totally Agree--------- Totally Disagree**						
1.	By adopting 5th Industry Revolution Technologies, I expect to **perform better** in my future career.	7	6	5	4	3	2	1
2.	By adopting 5th Industry Revolution Technologies, I expect to get **better job remunerations** (pay, bonus, promotion, compliment, recognition) in my future career.	7	6	5	4	3	2	1
3.	By adopting 5th Industry Revolution Technologies, I expect to **improve time and effort efficiency** in my future career.	7	6	5	4	3	2	1
4.	I expect to find **more job opportunities** for my personal growth and development in the 5th Industry Revolution era.	7	6	5	4	3	2	1
5.	I expect **job market requirements** are **ever-changing** in the 5th Industry Revolution era.	7	6	5	4	3	2	1
Life-long Learning Tendency		**Totally Agree---------Totally Disagree**						
1.	I feel that I am **better to evaluate** my **success as a learner** than others.	7	6	5	4	3	2	1
2.	It is my responsibility to **make sense of what I learn** all the times.	7	6	5	4	3	2	1
3.	I **plan learning** by **myself.**	7	6	5	4	3	2	1
4.	I **think about how to improve my own learning** over times.	7	6	5	4	3	2	1
5.	I **love learning** for my **betterment** over times.	7	6	5	4	3	2	1
6.	I like to **learn by asking and answering** questions.	7	6	5	4	3	2	1
7.	I **deal with the unexpected problems** and **solve them** as they arise.	7	6	5	4	3	2	1
8.	I feel **comfortable to deal with uncertainty** over times.	7	6	5	4	3	2	1
9.	When **I learn something new**, I try to **focus on the details** rather than on the 'big picture'.	7	6	5	4	3	2	1

Readiness to Adapt 5th Industry Revolution Technologies		**Totally Agree---------Totally Disagree**						
1.	I am able to **adapt the applications** of 5th Industry Revolution technologies in my future career.	7	6	5	4	3	2	1
2.	**I am comfortable** to adapt 5th Industry Revolution technologies in my future career.	7	6	5	4	3	2	1
3.	**I am prepared** for my future career in Industry Revolution 5.0 era.	7	6	5	4	3	2	1

Section C:

Please choose the number (7, 6, 5, 4, 3, 2 or 1) that best describes your perception on each of statement given below.

Number	***Descriptor***
7	Always
6	Very frequently
5	Frequently
4	Sometimes
3	Rarely
2	Very rarely
1	Never

Technological Knowledge Base		**Always ------------------------------ Never**						
1.	I **develop the technological skills needed** in adopting 5th Industry Revolution technologies over times.	7	6	5	4	3	2	1
2.	I **update knowledge** of 5th Industry Revolution Technologies **over times**.	7	6	5	4	3	2	1
3.	I **use** various **ways and strategies** to enhance my understanding of 5th Industry Revolution Technologies over times.	7	6	5	4	3	2	1
4.	I **follow** future **developments and technologies** of 5th Industry Revolution **over times.**	7	6	5	4	3	2	1
5.	I access **up-to-date resources** (ex, books, journals) of the 5th Industry Revolution technologies **over times.**	7	6	5	4	3	2	1
Critical Thinking Skills		**Always ----------------------------- Never**						
1.	I **open for ideas** that challenge my held beliefs.	7	6	5	4	3	2	1

2.	I **consider** various **arguments** to formulate my own point of view.	7	6	5	4	3	2	1
3.	I **justify** my own choice/point of view.	7	6	5	4	3	2	1
4.	I **filter** important **points** from a discussion.	7	6	5	4	3	2	1
5.	I **suggest new** related **points / ideas / inputs** to a discussion.	7	6	5	4	3	2	1
6.	I put a discussion into **a new perspective**.	7	6	5	4	3	2	1
Communication Skills		**Always ------------------------------ Never**						
1.	I **express my idea clearly** to others**.**	7	6	5	4	3	2	1
2.	I **get what I want from interactions** with people**.**	7	6	5	4	3	2	1
3.	I **acknowledge the message** raised during a discussion.	7	6	5	4	3	2	1
4.	I **make appropriate comments** in a discussion.	7	6	5	4	3	2	1
5.	I can **explain** my opinions and decisions.	7	6	5	4	3	2	1
Collaboration Skills		**Always ------------------------------ Never**						
1.	I complete an assigned task via **team effort.**	7	6	5	4	3	2	1
2.	I ensure **each team member** has his/her **contribution** to the assigned task.	7	6	5	4	3	2	1
3.	I **share resources, information, and work-related knowledge** among team members in completing the assigned task.	7	6	5	4	3	2	1
4.	I **coordinate** with team members to achieve a **common goal**.	7	6	5	4	3	2	1
5.	I make **decision** in an assigned task with **mutual respect** among team members involved.	7	6	5	4	3	2	1
Creativity Skills		**Always ------------------------------ Never**						
1.	I **imagine** things that do not yet exist.	7	6	5	4	3	2	1
2.	I **evaluate the usability** of my **generated ideas.**	7	6	5	4	3	2	1
3.	I give a **creative turn** / improvement to **existing processes** that I encounter.	7	6	5	4	3	2	1
4.	I **generate innovative ideas** in my area of study.	7	6	5	4	3	2	1
Problem Solving Skills		**Always ------------------------------ Never**						
1.	I manage to **solve most problems** even though initially no solution is immediately apparent / known.	7	6	5	4	3	2	1

2.	When I am aware of a problem, one of the first things I do is to try to **find out exactly what the problem is**.	7	6	5	4	3	2	1
3.	I **compare alternative solutions/opinions/ideas** available.	7	6	5	4	3	2	1
4.	I **decide and implement the best solution.**	7	6	5	4	3	2	1
5.	I **evaluate the effectiveness** of the implemented solution to the problem.	7	6	5	4	3	2	1

Appendix B

Online Questionnaire Survey in Google Form

Examining Performance-Related Variables of UTAR Kampar Undergraduates in Adapting Fifth Industry Revolution (IR 5.0) Technologies

Dear respondent, I am Year 3 Trimester 3 student from Bachelor of Science (HONS) Statistical Computing and Operations Research from University Tunku Abdul Rahman (UTAR) Kampar. I am currently conducting a survey among UTAR Kampar undergraduates to examine performance-related variables of UTAR Kampar undergraduates in adapting Fifth industry revolution (IR5.0) technologies.
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may access and update your personal data by writing to us at **irene2002@1utar.my**.

irene2002@1utar.my Switch account

* Indicates required question

Email *

☐ Record irene2002@1utar.my as the email to be included with my response

Acknowledgment of Notice: *

○ I have been notified by you and that I hereby understood, consented and agreed per UTAR notice.

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Next   Clear form

Concepts of 5th Industry Revolution

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For instance, traditional **3D printing** used to require lengthy setup times for customizing products. In the Fifth Industrial Revolution, 3D printing for mass customization can store printing programs. Customers can choose their preferred design, and a printer can produce the desired object, potentially at the point of use. This streamlined process significantly reduces the time needed for design, allowing for the rapid production of large volumes of customized products in just a few hours or less. Additionally, mass personalization is widely implemented in e-commerce platform, where it generates recommendations and promotions based on mass customers' recent searches.

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Back Next Clear form

Section A: Demographic Information

Gender *

- ◯ Male
- ◯ Female

Faculty *

- ◯ FSC
- ◯ FAS
- ◯ FBF
- ◯ FICT
- ◯ FEGT

Year of Study *

- ◯ Year 1
- ◯ Year 2
- ◯ Year 3
- ◯ Year 4 and above

Back | Next | Clear form

Section B

Please choose the number (7, 6, 5, 4, 3, 2 or 1) that best describes your perception on each of statement given below.

Number	***Descriptor***
7	Totally Agree
6	Very Agree
5	Agree
4	Neutral
3	Disagree
2	Very Disagree
1	Totally Disagree

Self-efficacy

1) I feel **confident about my ability** to adopt 5th Industry Revolution Technologies in my future career. *

	1	2	3	4	5	6	7	
Totally disagree	◯	◯	◯	◯	◯	◯	◯	Totally agree

2) I feel I am **on the top of things** (in full control) when I adopt 5th Industry Revolution Technologies in my future career. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

3) Things are **going on the way I want** to when I adopt 5th Industry Revolution Technologies in my future career. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

4) I can adopt 5th Industry Revolution Technologies **effectively** in my future career. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

Self-Adaptation of IR 5.0 Technologies

1) **I believe** 5th Industry Revolution Technologies is **useful** to support my future career. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

2) **I believe** 5th Industry Revolution Technologies is **valuable** to support my future career. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

3) **I believe** 5th Industry Revolution Technologies is **important** to support my future career. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

4) I **intend** to adopt 5th Industry Revolution Technologies in my future career. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

5) I **predict** I would adopt 5th Industry Revolution Technologies in my future career. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

6) I **plan** to adopt 5th Industry Revolution Technologies in my future career. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

7) As an end user, I find it is **easy to use** 5th Industry Revolution Technologies to do what I want it to do. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

8) As the end user, I believe interacting with 5th Industry Revolution Technologies **does not require a lot of my mental effort**. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

Job Performance Expectancy

1) By adopting 5th Industry Revolution Technologies, I expect to **perform better** in my future career. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

2) By adopting 5th Industry Revolution Technologies, I expect to get **better job remunerations** (pay, bonus, promotion, compliment, recognition) in my future career. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

3) By adopting 5th Industry Revolution Technologies, I expect to **improve time and effort efficiency** in my future career. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

4) I expect to find **more job opportunities** for my personal growth and development in the 5th Industry Revolution era. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

5) I expect **job market requirements** are **ever-changing** in the 5th Industry Revolution era. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

Life-long Learning Tendency

1) I feel that I am **better to evaluate** my **success as a learner** than others. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

2) It is my responsibility to **make sense of what I learn** all the times. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

3) **I plan learning** by myself. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

4) I **think about how to improve my own learning** over times. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

5) I **love learning** for my **betterment** over times. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

6) I like to **learn by asking and answering** questions. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

7) I **deal with the unexpected problems** and **solve them** as they arise. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

8) I feel **comfortable to deal with uncertainty** over times. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

9) When **I learn something new**, I try to **focus on the details** rather than on the 'big picture'. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

Readiness to Adapt 5th Industry Revolution Technologies

1) I am able to **adapt the applications** of 5th Industry Revolution technologies in my future career. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

2) **I am comfortable** to adapt 5th Industry Revolution technologies in my future career. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

3) **I am prepared** for my future career in Industry Revolution 5.0 era. *

	1	2	3	4	5	6	7	
Totally disagree	○	○	○	○	○	○	○	Totally agree

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Section C

Please choose the number (7, 6, 5, 4, 3, 2 or 1) that best describes your perception on each of statement given below.

Number	*Descriptor*
7	Always
6	Very frequently
5	Frequently
4	Sometimes
3	Rarely
2	Very rarely
1	Never

Technological Knowledge Base

1) I **develop the technological skills needed** in adopting 5th Industry Revolution technologies **over times.** *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

2) I **update knowledge** of 5th Industry Revolution Technologies **over times.** *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

3) I use various **ways and strategies** to enhance my understanding of 5th Industry Revolution Technologies **over times**. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

4) I **follow** future **developments and technologies** of 5th Industry Revolution **over times**. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

5) I access **up-to-date resources** (ex, books, journals) of the 5th Industry Revolution technologies **over times**. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

Critical Thinking Skills

1) I **open for ideas** that challenge my held beliefs. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

2) I **consider** various **arguments** to formulate my own point of view. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

3) I **justify** my own choice/point of view. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

4) I **filter** important **points** from a discussion. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

5) I **suggest new** related **points / ideas / inputs** to a discussion. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

6) I put a discussion into a **new perspective**. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

Communication Skills

1) I **express my idea clearly** to others. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

2) I **get what I want from interactions** with people. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

3) I **acknowledge the message** raised during a discussion. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

4) I **make appropriate comments** in a discussion. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

5) I can **explain** my opinions and decisions. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

Collaboration Skills

1) I complete an assigned task via **team effort**. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

2) I ensure **each team member** has his/her **contribution** to the assigned task. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

3) I **share resources, information, and work-related knowledge** among team members in completing the assigned task. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

4) I **coordinate** with team members to achieve a **common goal**. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

5) I make **decision** in an assigned task with **mutual respect** among team members involved. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

Creativity Skills

1) I **imagine** things that do not yet exist. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

2) I **evaluate the usability** of my **generated ideas**. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

3) I give a **creative turn** / improvement to **existing processes** that I encounter. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

4) I **generate innovative ideas** in my area of study. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

Problem Solving Skills

1) I manage to **solve most problems** even though initially no solution is immediately apparent / known. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

2) When I am aware of a problem, one of the first things I do is to try to **find out exactly what the problem is.** *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

3) I **compare alternative solutions/opinions/ideas** available. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

4) I **decide and implement the best solution.** *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

5) I **evaluate the effectiveness** of the implemented solution to the problem. *

	1	2	3	4	5	6	7	
Never	○	○	○	○	○	○	○	Always

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Appendix C

Turnitin Report

Universiti Tunku Abdul Rahman			
Guideline Title : **Generating Originality Report for Thesis/Dissertation/Project Report Using Turnitin**			
Guideline Number : GD-IAD-003	Rev No: 0	Effective Date: 01/10/2013	Page No: 12 of 12

<u>**Appendix 1-4**</u>

Universiti Tunku Abdul Rahman			
Form Title : Supervisor's Comments on Originality Report Generated by Turnitin for Submission of Final Year Project Report (for Undergraduate Programmes)			
Form Number: FM-IAD-005	Rev No.: 0	Effective Date: xx/xx/xxxx	Page No.: 12 of 1

FACULTY OF SCIENCE

Full Name(s) of Candidate(s)	THAM SHI YUN
ID Number(s)	20ADB04670
Programme / Course	SCOR
Title of Final Year Project	Examining performance related determinants of UTAR Kampar undergraduates in adapting Fifth Industry Revolution (IR 5.0) technologies.

Similarity	**Supervisor's Comments** **(Compulsory if parameters of originality exceeds the limits approved by UTAR)**
Overall similarity index: 17 **%** **Similarity by source** Internet Sources: 8 % Publications: 13 % Student Papers: 4 %	Only 1 individual source listed has 8% similarity in Turnitin Report. It is due to the source analyzed technological performance-related variables that are similar to this FYP report. However, the analysis in this FYP report is based on IR 5.0 technologies instead of GhatGPT in the source.
Number of individual sources listed of more than 3% similarity: 1	
Parameters of originality required and limits approved by UTAR are as follows: (i) **Overall similarity index is 20% and below , and** (ii) **Matching of individual sources listed must be less than 3% each , and** (iii) **Matching texts in continuous block must not exceed 8 words** *Note: Parameters (i) – (ii) shall exclude quotes, bibliography and text matches which are less than 8 words.*	

<u>Note</u> Supervisor/Candidate(s) is/are required to provide softcopy of full set of the originality report to Faculty/Institute

Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.

YHB Signature of Supervisor	Signature of Co-Supervisor
Name: YEOH HONG BENG	Name:
Date: 4/9/2024	Date:

Appendix D

Originally Report

Examining Performance-Related Determinants of UTAR Kampar Undergraduates in Adapting Fifth Industry Revolution (IR 5.0) Technologies.

ORIGINALITY REPORT

17%	8%	13%	4%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Hong Beng Yeoh, Zhi Hui Yap. "Examining technological performance-related variables for effective usage of ChatGPT in academic learning of tertiary learners", ITM Web of Conferences, 2024 Publication	8%
2	Submitted to Universiti Tunku Abdul Rahman Student Paper	1%
3	www.mubs.ac.ug Internet Source	<1%
4	Submitted to Ecole de Management de Normandie Student Paper	<1%
5	John R. Kirby, Christopher Knapper, Patrick Lamon, William J. Egnatoff. "Development of a scale to measure lifelong learning", International Journal of Lifelong Education, 2010 Publication	<1%