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**Exploring Contributing Factors and
Their Inter-relationships Towards
the Effective Usage of ChatGPT in
Academic Learning among UTAR
Kampar Undergraduates**

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**Exploring Contributing Factors and Their Inter-relationship Towards the
Effective Usage of ChatGPT in Academic Learning among UTAR
Kampar Undergraduates**

By

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ABSTRACT

Exploring Contributing Factors and Their Inter-relationship Towards the Effective Usage of ChatGPT in Academic Learning among UTAR Kampar Undergraduates

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Recently, ChatGPT is widely leveraged as information searching and drilling natural language processing tool to facilitate academic learning. However, a comprehensive framework is indeed lacking for its effective deployment in educational institutions. Thus, this research aims to analyze individual and technological performance-related variables and their inter-relationships while using ChatGPT to facilitate effective usage of ChatGPT among tertiary learners for their academic learning. Individual performance-related variables consist of tertiary learners' knowledge base of subject matter and 21st century learning

skills. On the other hand, technological performance-related variables comprise tertiary learners' technological self-efficacy, acceptance level and job expectancy while using ChatGPT. Quantitative research via questionnaire survey was conducted in this research. All question items in the questionnaire were adapted from past related studies. The respondents were recruited using multi-staged cluster sampling technique at UTAR Kampar campus. Data collected from 230 tertiary learners were analysed using Partial Least Square-Structural Equation Modeling (PLS-SEM).

In individual performance-related variables, the research findings show that tertiary learners' communication and problem solving skills significantly influence the effective usage of ChatGPT. Besides, learner's information literacy skills significantly influence both their communication and problem solving skills. In addition, collaboration skills have a significant effect on communication and information literacy skills. Moreover, learner's knowledge base of subject matter significantly influences all six 21st century skills analysed in this research. Furthermore, critical thinking skills and problems solving skills are partially mediated by learners' information literacy skills.

In technological performance-related variables, learners' job expectancy on the outcomes of using ChatCPT, self-efficacy, and behavioural intention to use ChatGPT significantly affect its effective usage in their academic learning. Besides, both tertiary learners' self-efficacy and job expectancy when using ChatGPT are significantly affected by their perceived usefulness and importance of ChatGPT. In addition, tertiary learners' self-efficacy in ChatGPT is also significantly influenced their behavioural intention to use it. Furthermore, the relationship between tertiary learners' perceived ease of use and their behavioural intention to use ChatGPT is partially mediated by their perceived usefulness and importance of ChatGPT.

These research results provide an insight to related stakeholders, including tertiary learners and higher education decision makers, on their initiatives to facilitate and manage the usage of ChatGPT as a learning tool in tertiary educational institutions.

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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.



YAP ZHI HUI

APPROVAL SHEET

This project report entitled “**Exploring Contributing Factors and Their Inter-relationship Towards the Effective Usage of ChatGPT in Academic Learning among UTAR Kampar Undergraduates**” was prepared by YAP ZHI HUI and submitted as partial fulfilment of the requirements for the degree of Bachelor of Science (Honours) Statistical Computing and Operations Research at Universiti Tunku Abdul Rahman.

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PERMISSION SHEET

It is hereby certified that **YAP ZHI HUI** (ID No: **19ADB03810**) has completed this final year project entitled “**Exploring Contributing Factors and Their Inter-relationship Towards the Effective Usage of ChatGPT in Academic Learning among UTAR Kampar Undergraduates**” 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,



(YAP ZHI HUI)

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LIST OF ABBREVIATIONS

AVE	Average Variance Extracted
BIU	Behavioural Intention to Use ChatGPT
CB-SEM	Covariance Based Structural Equation Modeling
CI	Confidence Interval
CLS	Collaboration Skills
CMS	Communication Skills
CRI	Composite Reliability Index
CSV	Comma-Separated Value
CTS	Critical Thinking Skills
EU	Effective Usage of ChatGPT
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

ILS	Information Literacy Skills
JE	Learners' Job Expectancy on ChatGPT
KB	Knowledge Base of Subject Matter
LLM	Large Language Models
LM	Linear Regression Model
MCA	Malaysian Chinese Association
PEU	Perceived Ease of Use of ChatGPT
PLS-SEM	Partial Least Square-Structural Equation Modeling
PSS	Problem Solving Skills
PUI	Perceived Usefulness and Importance of ChatGPT
RMSE	Root Mean Square Error
SE	Learners' Self-Efficacy to use ChatGPT
TAM	Technology Acceptance Model
TPACK	Technological Pedagogical Content Knowledge
UTAR	Universiti Tunku Abdul Rahman
VAF	Variance Accounted For
VIF	Variance-Inflation Factor
ρ_A	Dijkstra-Henseler's rho

CHAPTER 1

INTRODUCTION

Chapter 1 outlines background of organization involved as well as research problem statement, objectives, significance, and limitations. At the end of the chapter, the related contributing factors towards the effective usage of ChatGPT in academic learning of tertiary learners are defined and elaborated.

1.1 Introduction

OpenAI released Chat Generative Pre-Trained Transformer (ChatGPT) on 30th November 2022. It uses human language processing tool which is designed to understand the conversational context and generate responses that are relevant and captivating to the prompts provided by its users. ChatGPT adopts an advanced version of the GPT-3 family of large language models (LLM) that are specifically designed for conversational Artificial Intelligence (Abdullah et al.,2022). Nowadays, ChatGPT becomes increasingly popular as a learning tool in education. It is capable of answering academic prompts and queries raised by learners by integrating knowledge bases from various sources and subject areas, classifying and summarizing a given text and even debugging programming codes

(Abdullah et al.,2022). On top of it, ChatGPT engages in personalized, dynamic, interactive, and contextually relevant conversations with its end users (Deng et al.,2023).

According to Forman et al.(2023), ChatGPT plays a crucial role in shaping experiences and expectations in education. By introducing students to technology like ChatGPT, they not only gain exposure to innovation learning tools but also develop the skills and confidence to effectively utilize the technology in their academic learning. ChatGPT has shown significant benefits for students looking to improve their understanding in their academic subjects. Moreover, beyond improving their learning experience, ChatGPT contributes to the development of essential skills needed to successfully utilize it for better achievement in their academic learning.

As ChatGPT continues to evolve, learners encounter various challenges to use it. ChatGPT has the potential of providing fake and wrong information (Eken,2023). Besides, it might lead to academic cheating and plagiarism (Abdullah et al.,2022). If students over-reliance on ChatGPT, it has the potential to lead to their laziness and unlearning. Thus, students are required to have a foundational understanding of their relevant fields of study when utilizing ChatGPT so they are capable to critically evaluate the responses generated by ChatGPT (Shoufan, 2023).

Therefore, to leverage ChatGPT effectively, these associated risks need to be mitigated. Currently, there is a lack of comprehensive framework for effective deployment of ChatGPT in educational institutions. Thus, this research aims to analyze individual and technological performance-related variables while using ChatGPT and their inter-relationships to support effective usage of ChatGPT among tertiary learners in their academic learning. Individual performance-related variables consist of the learners' knowledge base on their subject matter and their 21st century learning skills while technological performance-related variables comprise their technological self-efficacy, acceptance level and job expectancy on ChatGPT.

1.2 Background of the research

The target population of this research consists of undergraduates from all five faculties at Universiti Tunku Abdul Rahman (UTAR) Kampar Campus, namely Faculty of Science (FSC), Faculty of Information and Communication Technology (FICT), Faculty of Business and Finance (FBF), Faculty of Arts and Social Science (FAS), and Faculty of Engineering and Green Technology (FEGT).

The research has two main objectives. The first objective is to examine the significance of performance-related variables that affect the effective usage of ChatGPT in academic learning among tertiary learners. The second objective is to study the inter-relationships

among these performance-related variables towards the effective usage of ChatGPT in the tertiary learners' academic learning.

1.3 Background of the research organization

Universiti Tunku Abdul Rahman (UTAR) was established in 2002 by the Malaysian Chinese Association (MCA). Currently, UTAR has two campuses that are located in Kampar, Perak and Bandar Sungai Long, Selangor respectively. The Kampar Campus serves as the main campus and was built on a 1300-acre piece of land donated by the Perak State Government. Currently, the university offers over 138 academic programs from foundation, undergraduate, and postgraduate levels. There are a total of five faculties in UTAR Kampar Campus, namely Faculty of Business and Finance (FBF), Faculty of Science (FSC), Faculty of Information and Communication Technology (FICT), Faculty of Engineering and Green Technology (FEGT), and Faculty of Arts and Social Science (FAS) (UTAR, n.d.). Indeed, UTAR is the target organization for this research study because it provides diverse academic programs and faculties. This diversity enables this research to evaluate tertiary learners' performance-related variables towards the effective usage of ChatGPT in their academic learning across different fields of their undergraduate studies.

1.4 Problem statement of the study

Most of the tertiary learners do not use ChatGPT effectively in their academic learning as the outputs generated by ChatGPT have the potential to provide biases and inaccurate responses (Deng et al.,2022). At the same time, learners might not be aware of ChatGPT's strengths and weaknesses. As a result of it, learners might not fully and effectively utilize ChatCPT to facilitate their academic learning. At present, there is a lack of related studies to investigate the influencing factors and their inter-relationships towards the effective usage of ChatGPT in the academic learning among tertiary learners.

1.5 Objectives of the study

The main objective of this research study is to examine the significant contributing factors that affect the effective usage of ChatGPT in the academic learning of tertiary learners. Besides, the research also studies the inter-relationships among these contributing factors towards the effective usage of ChatGPT in tertiary learners' academic learning.

1.6 Significance of the study

The findings of this research provide useful insight into the significant contributing factors and their inter-relationships toward the effective usage of ChatGPT in academic learning among UTAR Kampar undergraduates specifically and tertiary learners generally. By exploring these factors, tertiary learners are expected to effectively navigate and integrate ChatGPT in their academic learning. Ultimately, their tertiary educational experience and academic performance can be further enhanced over times.

Besides, upon realizing the significant contributing factors and their inter-relationships toward the effective usage of ChatGPT among UTAR undergraduates, UTAR management and academic staff can gain a deeper understanding of the challenges to leverage ChatGPT in their students' academic learning. As a result of it, they are expected to pull together their resources to facilitate the effective usage of ChatGPT for teaching and learning purposes. In line with this effort, the university management can establish clear guidelines to its students on when and how to use ChatGPT in their academic learning and introduce the best practices associated with integrating ChatGPT into the university's teaching and learning activities.

1.7 Limitations of the study

There are limitations in this research. This research focuses solely on the perspectives of undergraduate students at UTAR Kampar campus. As a result, the findings might not represent undergraduates' perspectives from UTAR Sungai Long Campus as well as other universities across Malaysia.

Besides that, the analyzed contributing factors toward the effective usage of ChatGPT are mainly based on past literature. As ChatGPT continues to evolve, new features and capabilities are expected to emerge. Therefore, the contributing factors might be required to further refine, explore, and extend over times.

As ChatGPT has the potential to provide inaccurate information and lead to academic plagiarism, future research is recommended to explore the effect of tertiary learners' self-performance-related variables, including their learning attitudes such as life-long learning and academic integrity, to facilitate effective usage of ChatGPT in academic learning among tertiary learners in Malaysia.

1.8 Definitions and descriptions of contributing factors towards the effective usage of ChatGPT in academic learning of tertiary learners in the research

In this study, the contributing factors towards the effective usage of ChatGPT in academic learning of tertiary learners consists of individual and technological performance-related variables. First and foremost, individual performance-related variables encompass factors related to individual characteristics and skills of learners. Specifically, it includes learners' knowledge base of subject matter and 21st century learning skills. 21st century skills are a set of abilities that are essential for students to thrive in a more digital, collaborative, and technology-driven world (Voogt et al.,2010). In this research, 21st century learning skills analyzed are critical thinking skills, communication skills, collaboration skills, problem solving skills and information literacy skills.

According to Venkatesh et al. (Venkatesh et al.,2003) and Yeoh et al. (Yeoh et al.,2023), the effective usage of technology was indeed influenced by various factors, including end users' technological job expectancy, self-efficacy, and acceptance level. These factors are categorized as technological performance-related variables. In this research, the acceptance level of ChatGPT is manifested by Technology Acceptance Model (TAM). The TAM model includes key factors for learners to adopt new technology, namely their perceived usefulness and importance of ChatGPT, behavioural intention to use ChatGPT and perceived ease of use of ChatGPT.

1.8.1 Individual performance-related variables

In this section, individual performance-related variables covered in this research are learners' knowledge base of subject matter, critical thinking skills, communication skills, collaboration skills, problem solving skills, and information literacy skills.

1.8.1.1 Knowledge base of subject matter

Content knowledge is crucial for learners to understand the subject matters that are related to their learning process. Content knowledge refers to the understanding that an individual possesses in a particular subject area (Sahin,2011). This understanding allows learners to make connections between different topics within a subject area. It facilitates integration of technology into their learning activities (Schmidt et al.,2009). In this research, tertiary learners' knowledge base of subject matter refers to their in-depth understanding in their respective academic fields of study.

1.8.1.2 Critical thinking Skills

According to Hakim et al. (2018), critical thinking skills emphasize the ability to analyze, evaluate, and synthesize information rationally and objectively. Developing critical thinking skills empowers students to engage deeply in complex issues and assess the credibility of information, sources, and arguments. Then it'll lead to improvement in the decision-making process. Moreover, critical thinking skills also help students in identifying biased information. This leads to more objective thinking of the learners (Saadé et al.,2012). Therefore, in this research, tertiary learners' critical thinking skills are defined as the ability of the learners to analyze accuracy and relevance of the responses obtained.

1.8.1.3 Communication skills

Communication skills refer to the ability to exchange information and ideas with others. The importance of communication skills highlights its significance in fostering understanding and connection between individuals (Jacobson-Lundeberg, 2016). Communication skills enable individuals to convey ideas clearly and receive feedback from others through various digital tools and platforms (Maican, 2019). In this research, the communication skills of learners refer to their abilities to transfer information to others in their academic learning.

1.8.1.4 Collaboration skills

Collaboration skills emphasize the ability to work effectively with others to accomplish shared goals and objectives. Collaboration skills are essential for success as they encompass a range of abilities that enable individuals to share the understanding to solve problems and make decisions based on mutual respect (Child et al.,2016). Collaboration skills enable students to use the information to learn and solve problems encountered in technology-driven environments (Wallace,2021). In this research, collaboration skills refer to learners' ability to work with others in their academic learning.

1.8.1.5 Problem solving skills

Problem solving is the ability of an individual to identify, analyze and overcome a problem with the most effective solution (Bariyyah, 2021). In the context of 21st century, problem solving skills involve leveraging technology to collect and assess information to facilitate decision-making. Individuals with strong problem solving skills are able to analyze situations, develop and implement the most appropriate strategy to overcome the problem faced (Iñiguez-Berrozpe et al.,2020). In this research, problem skills refer to learners' ability to solve problems faced in their assigned academic tasks.

1.8.1.6 Information literacy skills

Information literacy skills are a set of abilities for individuals to find, evaluate, and utilize information effectively. It enables individuals to work with a variety of technologies in daily life to complete tasks in today's digital era (Eisenberg, 2008). With information literacy skills, individuals can identify the needed information, and search for information effectively using various sources, such as online databases and search engines. It also enhances the capacity to critically evaluate the credibility, reliability, accuracy, and relevance of information obtained (Hepworth, 2000). In this research, information literacy skills refer to the ability of learners to recognize the information needed and apply the acquired information in their academic learning.

1.8.2 Technological performance-related variables

In this section, the technological performance-related variables analyzed are tertiary learners' technological job expectancy, self-efficacy, perceived usefulness and importance, behavioural intention to use and perceived ease of use of ChatGPT in their academic learning.

1.8.2.1 Learner's job expectancy for ChatGPT

Technological job expectancy refers to an individual expectation on the usage of a related technology that leads to improvement in his/her job performance (Venkatesh et al., 2003). The expectancy theory developed by Vroom (Vroom,1964) states that individuals make choices and engage in activities based on the expectation that certain actions taken lead to positive outcomes (Vroom et al.,2015). In this research, tertiary learners' job expectancy on ChatGPT refers to their perception on the outcomes of using ChatGPT for better academic performance as well as improved efficiency in their learning time and effort.

1.8.2.2 Learner's self-efficacy to use ChatGPT

Self-efficacy is one's belief in his/her ability to perform a specific task assigned and accomplish its goals (Latip et al.,2020). The degree of an individual's self-efficacy plays a crucial role in shaping his/her perseverance in learning new skills that impact his/her job performance (Mustafa et al.,2019). In this research, tertiary learners' self-efficacy is associated with their believed ability to use the ChatGPT. It involves the learner's confidence and capability to interact with the ChatGPT and generate responses that meet their academic learning goals or needs.

1.8.2.3 Learner's Acceptance Level to ChatGPT

Technological level of acceptance is interpreted as willingness of a person to recognize and embrace a new technology into his/her life or work (Venkatesh et al,2003). High level of acceptance of a technology among end users leads to the smooth integration of the adopted technology into organizations (Hero,2020). In this research, the acceptance level of ChatGPT is manifested by Technology Acceptance Model (TAM). It is widely utilized as a theoretical framework for evaluating users' adoption and acceptance of new Information Technology. TAM suggests that the perceived usefulness and ease of use of a technology are key factors that influence users' attitude and behavioural intention to use the technology (Venkatesh et al.,2003).

1.8.2.3.1 Perceived usefulness and importance (PUI)

Perceived usefulness focuses on the users' belief about the extent to which an adopted technology can enhance their job performance (Davis,1989). If users perceive a technology as a useful tool in improving their job efficiency and effectiveness, they are more likely to accept and adopt it (Yeoh et al.,2023). In this research, tertiary learners' perceived usefulness and importance refers to the degree to which they believe that using ChatGPT can enhance their academic learning outcomes.

1.8.2.3.2 Behavioural intention to use

One's behavioural intention to use a technology describes his/her expressed willingness to accept and adopt a particular technology (Aditia et al.,2018). In the context of TAM, behavioural intention to use a technology is a key factor that predicts whether the users are likely to adopt or use the technology (Venkatesh et al.,2003). In this research, tertiary learners' behavioural intention to use ChatGPT is reflected by their willingness to engage with ChatGPT and utilize it for their academic learning purposes.

1.8.2.3.3 Perceived Ease of Use

Perceived ease of use is the user's perception of how easy it is to use the technology (Davis, 1989). If users find a technology is easy to use, they are more inclined to accept and use it in their daily life (Yeoh et al.,2023). In this research, tertiary learners' perceived ease of use of ChatGPT is related to their belief about how user-friendly to interact with and utilize ChatGPT in their academic learning.

CHAPTER 2

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

In this research, the contributing factors toward effective usage of ChatGPT among tertiary learners are categorized into individual and technological performance-related variables. The individual performance-related variables encompass the learners' knowledge base of subject matter, critical thinking skills, collaboration skills, information literacy skills, communication skills and problem solving skills. On the other hand, the technological performance-related variables analyzed are the learners' job expectancy on ChatGPT, self-efficacy and behavioural intention to use ChatGPT as well as their perceived ease of use and perceived usefulness and importance of ChatGPT.

Chapter 2 outlines the literature review on the contributing factors and their inter-relationships towards the effective usage of ChatGPT in the learner's academic learning. It is followed by the construction of research hypotheses. At the end of this chapter, the research theoretical framework is established in accordance with the proposed hypotheses.

2.1 Individual Performance-Related Variables for Effective Usage of ChatGPT.

In this section, the relationships between individual performance-related variables, namely the learner' knowledge base of subject matter and their current perceived 21st century skills, and their effects on the effective usage of ChatGPT are explored and outlined in the hypotheses constructed.

2.1.1 Tertiary learners' knowledge base of subject matter and their effective usage of ChatGPT in academic learning.

Subject matter knowledge is essential for encouraging adoption and maximizing the effective usage of the technology (O'brien et al.,2012). Having relevant knowledge plays a crucial role in ensuring successful utilization of technology as it enables individuals to leverage technology more effectively to meet their specific needs. Users with high knowledge of the subject matter allow them to critically evaluate the relevance and accuracy of information obtained through the technology adoption (Shapiro,2004). According to the Technological Pedagogical Content Knowledge (TPACK) framework, content knowledge, which is the knowledge about the subject matter, is indeed a critical component for effective usage of technology. From the research conducted by Schmidt et

al.(2009), knowledge base of the subject matter among educators has a significant influence on effective usage of technology in their teaching practices. Educators keep themselves up-to-date information so that they are able to leverage the latest developments and applications of related technologies to create engaging learning experiences and lead to effective usage of the technologies. Thus, the alternative hypothesis below is developed.

H_{a1}: Tertiary learners' knowledge base of subject matter has significant effect on the effective usage of ChatGPT in their academic learning.

2.1.2 Tertiary learners' knowledge base of subject matter and their collaboration skills.

Prior knowledge is crucial for enhancing collaborative success in accomplishing a particular task. When individuals have more in-depth knowledge base of the subject matter, they are more prepared to engage in collaborative assignments. The knowledge base of subject matter promotes collaboration skills as it allows an individual to communicate ideas clearly, share resources, information and work-related knowledge with others as well as work towards shared goals with team members (Nokes-Malach et al.,2012). If team members in a collaborative assignment lack of knowledge base on their respective subject matters, it might lead to unsuccessful collaboration as they are unable to provide useful opinions to meet the objectives and goals of the assignment (Ibrahim & Rashid,2022). Hence, the following alternative hypothesis is proposed.

H_{a2}: Tertiary learners' knowledge base of subject matter has significant effect on their collaboration skills.

2.1.3 Tertiary learners' knowledge base of subject matter and their communication skills.

According to Wu et al. (2007), the knowledge base leads to effective communication. When an individual has a deeper understanding of a subject, his/her ability to convey information and ideas to others as well as to identify and understand the message raised in the discussion. The knowledge base allows individuals to express their thoughts or opinions more accurately. The more knowledge an individual has, the more effective his/her involvement in communication with others. On top of it, students with an in-depth knowledge base in subject matter are able to verbally convey their message and information clearly to others. By participating in a conversation, students are able to contribute their understanding of knowledge. At the same time, they also learn from the perspectives and experiences shared by others. Moreover, an individual who has strong knowledge base of his/her subject matter builds their confidence to exchange ideas. This leads to the improvement of their communication skills over times (Dixon & Beverly, 2015). Thus, the following alternative hypothesis is postulated.

H_{a3}: Tertiary learners' knowledge base of subject matter has significant effect on their communication skills.

2.1.4 Tertiary learners' knowledge base of subject matter and their critical thinking skills.

The knowledge base of students has a significant impact on their critical thinking skills. Critical thinking skills rely on the knowledge base of students as it enables them to get involved in educational tasks such as data analysis, knowledge evaluation and synthesis. In essence, critical thinking focuses more on learning processes that require students to actively apply their understanding to assess and solve problems (Hakim et al.,2018). According to Yu et al.(2014), students' critical thinking abilities are positively correlated with their applications of the related conceptual knowledge. Having appropriate conceptual knowledge is crucial for critical thinking as it provides the necessary foundation to suggest new related ideas, open for ideas from others on problematic issues, and justify actions taken to meet the objective of an assigned task. By leveraging their conceptual knowledge, students can effectively analyze problems, evaluate evidence and draw reasoned conclusions. Therefore, the following alternative hypothesis are initiated.

H_{a4}: Tertiary learners' knowledge base of subject matter has significant effect on their critical skills.

2.1.5 Tertiary learner's knowledge base of subject matter and their information literacy skills.

According to Walton et al. (2004), access to information is closely linked to a strong knowledge base. The knowledge base significantly impacts the quality of access to information as students with prior knowledge possess the ability to critically evaluate them. Moreover, a strong knowledge base is crucial for students to develop awareness of information evaluation. When students have a foundational understanding of a subject, they can better recognize the information needed in their learning (Walton,2004). Learning information literacy skills are associated with knowledge base. The knowledge base provides a framework for students to analyze and interpret information. Additionally, knowledge of subject matter allows students to apply information ethically and lawfully to solve problems in their academic learning (Hepworth,2000). Thus, the following hypothesis are initiated.

H_{a5}: Tertiary learners' knowledge base of subject matter has significant effect on their information literacy skills.

2.1.6 Tertiary learners' knowledge base of subject matter and their problem solving skills.

Komarudin et al.(2020) highlight the crucial role of prior knowledge in problem-solving skills. Individuals with knowledge in their respective expertise find it easier to solve problems within that domain. They can effectively decide and implement the best solution based on the available resource as well as apply the relevant theories, concepts, or formulas to explore different problems and identify the most effective solution. Prior knowledge provides understanding and enables individuals to accurately identify the problem and think of alternatives to solve it. Prior knowledge is undeniably crucial when approaching problems as it provides a foundation for understanding the situation and choosing the best solution to solve it. Knowledge helps to set up the connection as it allows individuals to see what the problems are and allow them to solve most problems even though initially no solution is immediately apparent (Liljedahl et al.,2016). Hence, the alternative hypothesis below is presumed.

H_{a6}: Tertiary learners' knowledge base of subject matter has significant effect on their problem solving skills.

2.1.7 Tertiary learner's communication skills and effective usage of ChatGPT in their academic learning.

Communication skills are important in the effective application of technology. Communication skills not only involve face-to-face communication but also virtual internet platforms like email and chat. Technology provides useful information and recommend relevant solutions to its end users if they express their ideas clearly via the interfaces provided by the technology. Hence, users' productivity and workflow efficiency can be further enhanced. Additionally, users who are able to communicate well will lead to a more efficient transfer of learning resources which in turn lead to better achievement as well as time and cost efficiency (Maican et al., 2019). When learners utilize technology for educational purposes, they are not only recipients of information but also have an active role in learning to ensure their full understanding of the information obtained before they can use it effectively in their learning process (Gilakjani, 2017). Thus, the following hypothesis is proposed.

H_{a7}: Tertiary learners' communication skills have significant effect on the effective usage of ChatGPT in their academic learning.

2.1.8 Tertiary learner's collaboration skills and communication skills.

The collaborative learning activities significantly impact students' communication skills. In collaborative learning, students are involved in various group activities, discussions, and assignments, where they are encouraged to share their concepts and ideas as well as to solve problems. These structures of activities are designed to foster meaningful learning experiences and develop students' communication skills. Besides, collaboration often involves providing and receiving ideas. Through these interactions, students learn to express their opinions and needs clearly. As a result, their communication skills are further enhanced (Patel et al., 2012). The collaboration skills utilized during learning activities, such as discussion of grouped assignments, enable students to share their resources, information, and work-related knowledge. These activities lead to more effective communication to complete the assigned task given. Collaborative learning motivates students to communicate as when they coordinate with team members to achieve a common goal. They need to share their ideas clearly and listen to their teammates' perspectives. Hence, learners' collaboration skills significantly influence their communication skills (Kusmiarti et al., 2020). In line with this argument, the following hypothesis is developed.

H_{a8}: Tertiary learners' collaboration skills have significant effect on their communication skills.

2.1.9 Tertiary learner's collaboration skills and information literacy skills.

Wallace (2021) stated the importance of collaboration skills in education, particularly between teachers and students, and the use of technology as a learning tool. Collaboration skills are highlighted as a key factor in enhancing the teaching and learning process by fostering greater learning effectiveness among learners. By working together on tasks, teachers and students get involved in discussion and sharing resources. These efforts will enhance their collaboration skills and then directly impact their information literacy skills by developing their ability to understand and evaluate the information effectively. The success of information literacy skills depends on collaboration between lecturers and students. This collaborative effort fosters a deeper understanding and enables students to critically evaluate information needed in their academic learning. Hence, the learners' information literacy skills are further enhanced (Nayda et al.,2008). Therefore, the following alternative hypothesis is established.

H_{a9}: Tertiary learners' collaboration skills have significant effect on their information literacy skills.

2.1.10 Tertiary learners' critical thinking skills and effective usage of ChatGPT in their academic learning.

According to Wilkins (2003), critical thinking significantly influences the academic performance of students. Students who apply critical thinking tend to achieve better performance. When utilizing technology, students need to focus on evaluating the relevance and validity of the information that is needed as well as using the acquired information ethically. With strong critical thinking skills, students are able to determine the information that is relevant and necessary for their academic learning. That leads to improvements in their academic performance. Yu et al.,(2015) also stated that there is a positive correlation between student's critical thinking skills and their performance in utilizing technology. It's because the level of critical thinking skills will influence students' ability to interpret the information, which in turn affects their decision-making process. Students with a high level of critical thinking skills are more capable of reflecting on the effects of technological development. They are also able to recognize biases and incorrect information and allow them to develop the most appropriate solution to their academic problem faced in their learning process. Consequently, critical thinking skills contribute to a deeper understanding of information and lead to the effective usage of technology. Thus, the following hypothesis is initiated.

H_{a10}: Tertiary learners' critical thinking skills have significant effect on the effective usage of ChatGPT in their academic learning.

2.1.11 Tertiary learner's critical thinking skills and their information literacy skills.

Information literacy skills are the abilities of individuals to evaluate, locate, and use information effectively. The evaluation process of information requires critical thinking skills. Critical thinking skills are essential for undergraduates to identify relevant information in their subject matter in order to achieve better academic results (Albitz, 2007). Critical thinking is a central component of information literacy skills as it enables individuals to identify misinformation and improve their skills to locate information required efficiently and utilize it effectively (Grafstein, 2017). Hence, the following alternative hypothesis is initiated.

H_{a11} : Tertiary learners' critical thinking skills have significant effect on their information literacy skills.

2.1.12 Tertiary learners' critical thinking skills and their problem solving skills.

Critical thinking skills are closely related to problem solving skills. Critical thinking might influence the individual's ability to identify and address problems effectively. The ability to think critically is essential for individuals to decide and implement the best solution to a problem. Critical thinking helps to promote careful examination and understanding of the

problem that occurs. Thus, with the critical thinking skills, individuals can make thoughtful decisions and determine the most suitable solution to resolve the problem faced (Yu, et al., 2015). Critical thinking skills involve the ability to analyze and evaluate information logically. It embeds the skills to identify a problem that occurs and choose the most effective solution to the problem based on the available resources (Budden, 2017). Thus, the following hypotheses are developed.

H_{a12}: Tertiary learners' critical thinking skills have significant effect on their problem solving skills.

2.1.13 Tertiary learner's information literacy skills and effective usage of ChatGPT in their academic learning.

According to Adeleke et al.(2016), information literacy have a significant impact on the usage of technology. To effectively utilize the variety resources of information available, individuals must develop search skills which involves exploring available information to interpret and utilize it for decision-making. As technology continues to evolve rapidly in education, information literacy is becoming increasingly important in the learning process. The ability to access, evaluate, and use information is required for a lifelong learning, ultimately leading to better achievement in academic learning. Indeed, while technology provides information, possessing information literacy skills is crucial for evaluating and utilizing the information effectively. Information literacy skills can increase the awareness

of individuals to identify and apply information obtained via effective usage of the information searching technologies (Bawden,2001). Thus, the following hypotheses are initiated.

H_{a13}: Tertiary learners' information literacy skills have significant effect on the effective usage of ChatGPT in their academic learning.

2.1.14 Tertiary learners' information literacy skills and their communication skills.

The ability to search and utilize information is essential as technology is rapidly evolving. Technology has provided the opportunity to exchange information, leading to an expansion of communicative possibilities. By being able to critically evaluate information, individuals can efficiently navigate the vast amount of information available, and then apply the most relevant and useful information to meet their needs. Besides, information literacy skills help them to identify the validity of information, empowering them to communicate with more confidence (Cardoso et al., 2018). Bruce (2002) stated that information literacy skills enhance student's utilization of resources and facilitate better sharing and understanding on knowledge taught in the classroom. Additionally, information literacy serves as the basis for effective communication by enabling students

to share information confidently in their learning process. Thus, the following hypotheses are tested.

H_{a14}: Tertiary learners' information literacy skills have significant effect on their communication skills.

2.1.15 Tertiary learners' information literacy skills and their problem solving skills.

Information literacy skills are vital for developing problem solving skills. It enhances students' ability to identify the problem and assess the validity of information, then decide the most feasible solution, leading to more effective solution implemented (Kennedy et al.,2020). Besides, Baji et al.(2018) also claimed that information literacy skills can improve problem solving skills. As information literacy skills foster the learners' ability to analyze information and identify problems, students are able to develop effective solutions in a shorter time. Thus, the following hypothesis is constructed.

H_{a15}: Tertiary learners' information literacy skills have significant effect on their problem solving skills.

2.1.16 Tertiary learners' problem solving skills and effective usage of ChatGPT in their academic learning.

The integration of technology in education serves multiple purposes, including acquiring knowledge, communicating with others and completing academic tasks. Consequently, problem solving skills are essential for the usage of technology to solve problems or tasks. Strong problem solving skills allow students to identify and overcome the problem when utilizing technology in their learning process, leading to a better result (Iñiguez-Berrozpe, 2020). Yunu et al.(2021) also claims that students with problem solving skills have a higher effectiveness in utilizing technology. Students have the ability of problem solving are able to follow up with the development of information technology in order to achieve their learning objectives. Thus, students are expected to improve performance and learning experience with problem solving skills. As a result of it, the following alternative hypothesis is established.

H_{a16}: Tertiary learners' problem solving skills have significant effect on the effective usage of ChatGPT in their academic learning.

2.1.17 Tertiary learner's critical thinking, information literacy and their problem solving skills.

Successful problem solving relies on critical thinking skills and information literacy skills (Yu, et al., 2015; Kennedy et al., 2020). In addition, information literacy skills also have a significant influence on the problem solving skills (Baji et al., 2018). Students who are able to analyze and evaluate the information gathered have better access to the information needed and capability to solve problems (Flood, 2015). Therefore, the proposed hypothesis is stated as follows.

H_{a17}: The relationship between tertiary learners' critical thinking skills and problem solving skills is mediated by their information literacy skills.

2.2 Technological Performance-Related Variables for Effective Usage of ChatGPT

In this section, the relationships between technological performance-related variables, namely the tertiary learner's job expectancy on ChatGPT, self-efficacy to use ChatGPT and acceptance level toward ChatGPT, and their effects on the effective usage of ChatGPT are analyzed based on past literature review before the related hypotheses are initiated.

2.2.1 Tertiary learners' job expectancy on ChatGPT and effective usage of ChatGPT in their academic learning.

End users' positive job expectancy on the adaptation of a new technology significantly influences their present and future actions to leverage the technology (Sang, 2018). In other words, end users who expect an adopted technology to bring about better work performance and efficiency tend to use the technology. More specifically, the users having positive job expectancy of ChatGPT are more likely to adopt it to complete their assigned tasks (Shahsavari et al., 2023). Therefore, the following hypothesis is proposed.

H_{a18}: Tertiary learners' job expectancy on ChatGPT has significant effect on its effective usage in their academic learning.

2.2.2 Tertiary learners' job expectancy on ChatGPT and their self-efficacy to use it.

According to the research carried out by Williams et.al (2010), expected outcomes of a person's behavior influence his/her level of self-efficacy. How individuals respond to their self-efficacy is determined by their expectations of the outcomes. More specifically, end users' job expectancy on a technology has significant influence on their self-efficacy to use the technology (Latip et al., 2020). So, the following hypothesis is established.

H_{a19}: Tertiary learners' job expectancy on ChatGPT has significant effect on their self-efficacy to use it in their academic learning.

2.2.3 Tertiary learners' self-efficacy to use ChatGPT and effective usage of ChatGPT in their academic learning.

The effective usage of technology and its goals hinge significantly on the perceived self-efficacy of users. Individuals who possess high self-efficacy in leveraging a technology have greater success in the usage of the technology (Celik et al., 2013). In addition, an individual with a strong belief in his/her ability to perform technological job assignments

has significantly enhanced his/her performance to complete them both qualitatively and quantitatively (Renn, 2001). Thus, the following hypothesis is initiated.

H_{a20}: Tertiary learners' self-efficacy to use ChatGPT has significant effect on its effective usage in their academic learning.

2.2.4 Tertiary learners' self-efficacy to ChatGPT and their behavioural intention to use it.

According to De Vries et al. (1988), self-efficacy significantly influences one's intention to engage in a behaviour. When individuals have a strong belief in their ability to perform well in a specific behavior, they are more likely to engage in that behavior. Furthermore, technology self-efficacy plays a crucial role in determining individuals' behavioural intention to use the technology as it reflects the acceptance level of the users towards the technology. Users with higher self-efficacy will have higher intention to adopt the technology in daily lives (Ariff et al., 2012). Therefore, the hypothesis below is proposed.

H_{a21}: Tertiary learners' self-efficacy to use ChatGPT has significant effect on their behavioural intention to use it.

2.2.5 Tertiary learners' behavioural intention to ChatGPT and its effective usage in their academic learning.

Venkatesh et al. (2003) stated that users' behavioural intention to use a technology is positively related their actual behavior to use the technology. For users having stronger intention to use the technology, they are more likely to accept and use it (Chen et al., 2011). Besides, Shahsavar and Choudhury (2023) also found that users' actual usage of ChatGPT is influenced by their behavioural intention to use it. Hence, the following hypothesis is tested.

H_{a22}: Tertiary learners' behavioural intention to use ChatGPT has significant effect on its effective usage in their academic learning.

2.2.6 Tertiary learners' job expectancy on ChatGPT and their behavioural intention to use it.

A person's intention to engage with a behavior is based on his/her expectation and evaluation on the outcomes of such behavior (Chen et al., 2011). According to research carried out by Chen et al. (2011), students' behavioural intention to use a technology is primarily influenced by their job expectancy on the technology. Job expectancy is closely

ted to end users' perception of the technology's functionalities and its effectiveness in helping them to perform their assigned tasks. Nikou and Economides (2017) also stated that job expectancy is a significant determinant of behavioural intention to use an adopted technology. As a result, the following hypothesis is set up.

H_{a23}: Tertiary learners' job expectancy on ChatGPT has significant effect on their behavioural intention to use it in their academic learning.

2.2.7 Tertiary learners' perceived ease of use, behavioural intention to use and perceived usefulness and importance of ChatGPT.

The Technological Acceptance Model 2 (TAM2) has identified users' perceived ease of use influences their perceived usefulness and behavioural intention to use Information Technologies (Venkatesh et al., 2000). It is consistent with the research findings by Baharin et al. (2015). A user-friendly technology improves overall users' experience on its usefulness that leads to its better adaptation and usage (Raksadigiri et al., 2020). Hence, the following hypotheses are initiated.

H_{a24}: Tertiary learners' perceived ease of use of ChatGPT has significant effect on their behavioural intention to use it in their academic learning.

H_{a25}: Tertiary learners' perceived ease of use of ChatGPT has significant effect on their perceived usefulness and importance of ChatGPT.

2.2.8 Tertiary learners' perceived usefulness and importance, behavioural intention to use, job expectancy and self-efficacy of ChatGPT.

The Technology Acceptance Model 3 (TAM3) identifies users' perceived usefulness has a significant influence on their behavioural intention to adopt and use a technology (Venkatesh et al, 2008). Besides, Chin et al. (2022) found that users' perceived usefulness and importance in Artificial Intelligence (AI) positively influences their behavioural intention to use its services. The relationships among perceived technological usefulness and importance, job expectancy, behavioural intention to use and self-efficacy are further justified by the research findings by Yeoh et al. (2023). Users who find technology useful and important tend to expect more positive outcomes when using the technology. As a result of it, they are more motivated to use technology. Consequently, users' self-efficacy in leveraging the technology is expected to be further reinforced. Thus, the following hypotheses are constructed.

H_{a26}: Tertiary learners' perceived usefulness and importance of ChatGPT has significant effect on their behavioural intention to use it in their academic learning.

H_{a27}: Tertiary learners' perceived usefulness and importance of ChatGPT has significant effect on their job expectancy of ChatGPT.

H_{a28}: Tertiary learners' perceived usefulness and importance of ChatGPT has significant effect on their self-efficacy to use it.

2.2.9 Tertiary learners' perceived ease of use, perceived usefulness, and importance of ChatGPT, and behavioural intention to use ChatGPT.

According to studies carried out by Venkatesh and Davis (2000) and Venkatesh and Bala (2008), users' perceived ease of use of a technology has an indirect impact on their behavioural intention to use the technology. Besides, there are significant positive relationships among perceived usefulness and importance, perceived ease of use and behavioural intention to use a technology (Almahamid et al., 2010; Widiar et al., 2023). Users who find technology easy to use are expected to perceive it as useful and important. These positive perceptions subsequently influence users' behavioural intention to use the technology. In line with this presumption, the following hypothesis is put forward.

H_{a29}: The relationship between tertiary learners' perceived ease of use and behavioral intention to use ChatGPT is mediated by their perceived usefulness and importance of ChatGPT.

2.3 Research theoretical framework

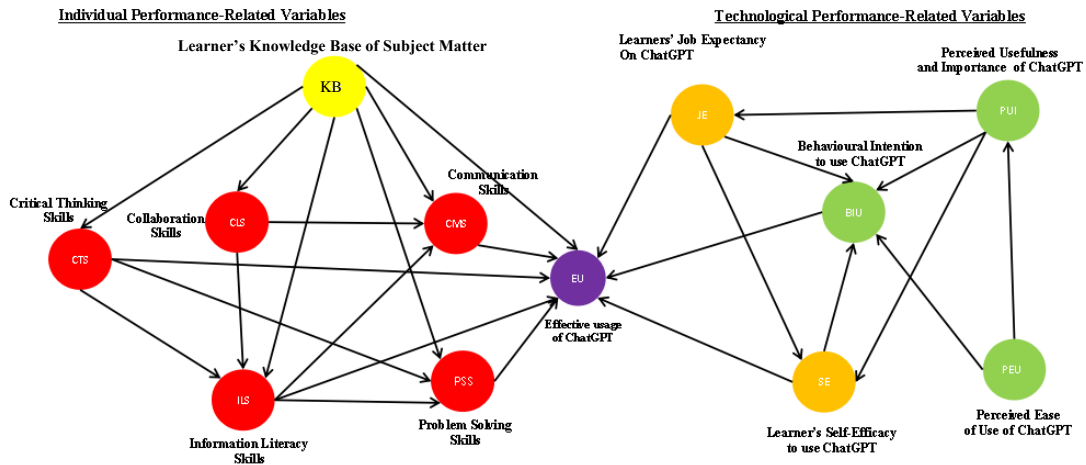


Figure 2.3: The theoretical framework of the research.

The hypotheses developed are summarized to form the research theoretical framework as shown in Figure 2.3. This framework indicates the contributing factors considered and their inter-relationships towards individual and technological performance-related variables toward the effective usage of ChatGPT in learners' academic learning.

CHAPTER 3

METHODOLOGY

Chapter 3 describes the methodology used to conduct the research including the research design, the target population and sample, the sampling method utilized, and the data collection process. Towards the end of the chapter, the data analysis process for Partial Least Squares-Structural Equation Modeling (PLS-SEM) is also elaborated.

3.1 Introduction

The main aim of the research is to identify the contributing factors to the effective usage of ChatGPT in academic learning among tertiary learners. Besides, this study also analyzes inter-relationships among individual and technological performance-related variables and their impacts on the effective usage of ChatGPT in academic learning among tertiary learners. Individuals' performance-related variables include learners' knowledge base of subject matter, critical thinking skills, communication skills, collaboration skills, problem solving skills, and information literacy skills. On the other hand, the technological performance-related variables analyzed in the research are tertiary learners' technological

job expectancy, self-efficacy, and acceptance level toward the effective usage of ChatGPT in their academic learning.

3.2 Research design

According to Rahi (2017), the research design encompasses the methods used for collecting and analyzing data. It serves as a framework to guide the researcher in achieving the research objectives. The aim of the research is to identify significant contributing factors and their inter-relationships towards the effective usage of ChatGPT in academic learning from the perception of undergraduates from Universiti Tunku Abdul Rahman (UTAR) Kampar Campus . The target population for this study comprises all undergraduates from all five faculties in the main campus of the university.

The research design applied for this study is quantitative research via a questionnaire survey. All question items in the designed questionnaire are adapted from past literature. The questionnaire consists of four sections. The first section includes the undergraduate's demographic information namely gender, and faculty. Section B includes question items regarding individual performance-related variables namely knowledge base of subject matter, learners' critical thinking skills, communication skills, collaboration skills, problem solving skills, and information literacy skills. It is followed by Section C that

consists of inquiry question items that relate to respondent's perceptions on technological performance-related variables, namely technological job expectancy, self-efficacy, perceived usefulness and importance, perceived ease of use, and behavioural intention to use. Lastly, section D consists of question items regarding the effective usage of ChatGPT.

The question items in the questionnaire, except for the section on demographic information (Section A), use a seven-point Likert scale. In the section that focuses on individual performance-related variables and technological performance-related variables, a frequency-based Likert scale consisting of options of never (1), very rarely (2), rarely (3), sometimes (4), frequently (5), very frequently (6), and always (7) is used to discern the frequency with which learners evaluate the related activities expressed in the research questionnaire. On the other hand, the Likert scale comprising options of totally disagree (1), strongly disagree (2), disagree (3), neutral (4), agree (5), strongly agree (6), and totally agree (7) is applied to analyze the perceived effectiveness of using ChatGPT by tertiary learners in their academic learning.

The question items in the designed questionnaire are adapted and compiled from the efforts of Sahin (2011), Hepworth (2000), Singh et al. (2008), Van Laar et al. (2019), Han et al. (2023) and Yeoh et al. (2023).

3.3 Population and sample

The target population for this study comprises all undergraduates from all the five faculties in the main campus of UTAR, namely the Faculty of Science (FSC), Faculty of Information and Communication Technology (FICT), Faculty of Business and Finance (FBF), Faculty of Arts and Social Science (FAS) and Faculty of Engineering and Green Technology (FEGT). The research study focuses on the UTAR Kampar Campus as it offers a variety of academic programs in different faculties. This criterion allows the exploration of the factors that contribute to the effective usage of ChatGPT in the learner's academic learning and their inter-relationship among undergraduates from different academic fields of study.

3.4 Sampling method and procedure

The sampling technique deployed in the research is multi-staged cluster sampling as the target population of the university's tertiary learners is naturally categorized into distinct clusters based on the faculty attached, the degree program registered, and the courses attended in each trimester. Multi-staged cluster sampling allows for the selection of a diverse range of primary sampling units at each stage, which can enhance the representativeness of the sample and provide a more accurate reflection of the population. Besides, this sampling technique saves cost and time when the fieldwork of this research is conducted (Ahmed et al., 2017). In the first stage, a degree program is randomly selected

from all undergraduate programs offered by each of the five faculties at the university. The list of all five faculties that are available in UTAR Kampar campus can be obtained through the university's official website. Then, an offered course is randomly chosen from each selected degree program from the five faculties. After that, from a list of scheduled lectures for each of the selected courses, a lecture time slot is randomly chosen. Then, an email will be sent to the respective lecturers to get permission to do the research fieldwork at the determined lecture times. Finally, the students who attend the chosen lecture time will participate in the questionnaire survey. Those students who are absent from the lecture in the selected lecture time slots are considered as non-response cases in this research.

3.5 Data collection procedure

In this study, a questionnaire survey was utilized to collect data from the identified samples using the applied sampling techniques. The questionnaire survey is collected via Google Forms. The Google Form link and QR code were prepared for the questionnaire survey to take place.

3.6 Data analysis procedure

There was a total of 230 respondents involved in this research fieldwork. The data were then saved in an Excel CSV file, then imported into SmartPLS 4 for further analysis.

3.6.1 Data analysis using Partial Least Squares-Structural Equation Modeling (PLS-SEM)

In this research, Partial Least Squares-Structural Equation Modeling (PLS-SEM) is used for data analysis as it is well-suited for studying complex models with various latent constructs. Its algorithm involves the usage of partial least squares method to estimate the parameters of a research structural model in order to predict the variation of endogenous constructs of the model by applying ordinary least squares regression models of the exogenous constructs in it. Besides, it is robust to analyze small size of data collected that do not strictly follow the assumption of a multivariate normal distribution. In this research, PLS-SEM is more preferred compared to Covariance Based Structural Equation Modeling (CB-SEM) because the research framework is causal and predictive in nature (Hair et al.,2019).

3.6.2 Evaluation of PLS-SEM

Evaluation of PLS-SEM focuses on two steps. The first stage is to evaluate the research's measurement model to ensure all the indicators of the constructs in the research theoretical framework satisfy the criteria for internal consistency and reliability of the indicators as well as the constructs' convergent and discriminant validity (Hair et al., 2019). Upon meeting these criteria for the measurement model, the data analysis will be followed by evaluating the research's structural model. Evaluating structural models involves examining the relationships between constructs specified in the research framework to determine their statistical significance and the overall fit of the research model by the data collected from research fieldwork (Hair et al., 2019).

3.6.2.1 Reflective measurement model analysis

The first step is evaluating the measurement model to address the indicators' loadings of latent constructs in the research theoretical model. The indicators' loadings prefer to be above 0.708 to ensure item reliability for the constructs in the model. An indicator loading value exceeding 0.708 indicates that the latent construct explains more than fifty percent of the variation in the indicator (Hair et al., 2019).

Then, the second step is the assessment of the internal reliability of constructs in the research theoretical model. Cronbach's alpha is suggested to be used to measure internal reliability. It concluded that the higher values of composite reliability indicate higher levels of internal reliability in the construct. However, Cronbach's alpha is considered less accuracy for reliability evaluation due to its inability to incorporate item weighting. To address this limitation, Dijkstra-Henseler's rho (ρ_A) value is used to measure a construct's internal reliability as its value lies between composite reliability and Cronbach's alphas. The values of composite reliability, Cronbach's alpha, and Dijkstra-Henseler's rho (ρ_A) for all the constructs in the research studied model are recommended to be higher than 0.7 to indicate satisfactory internal reliability (Hair et al., 2019).

The final step involves evaluating the convergent validity of indicators toward latent constructs in the research model. It assesses the extent each construct can account for the variance of its indicators. The Fornell-Larcker criterion compares the square of the correlation coefficients between latent constructs with the average variance extracted (AVE) of each construct in the research theoretical framework. In essence, for each construct, the AVE value should be higher than the squared correlation coefficients between that construct and all other constructs in the model. An AVE value of 0.50 or higher is considered acceptable and indicates that the construct can explain more than half of the variance in its indicators (Hair et al., 2019).

3.6.2.2 Structural model analysis

The variance-inflation factor (VIF) is used to evaluate the collinearity among the exogenous constructs in the research theoretical framework. All VIF values for the constructs are suggested to lie in between 1 and 5, as values exceeding 5 indicate significant collinearity problems among the exogenous constructs to an endogenous construct in the research theoretical model (Hair et al., 2019).

PLS-SEM is a non-parametric statistical method as the bootstrapping method is used to estimate statistical significance on the relationships among constructs in the research theoretical framework. It is robust to analyze the small size of sample data collected. Besides, it does not need to strictly follow the assumption of a multivariate normal distribution. To detect significant path coefficients, the percentile method with a significance level of 0.05 is used to construct bootstrapping confidence intervals (Hair et al., 2019). If the 95% bootstrap confidence interval of an indicator contains zero, then there is no statistically significant effect of an exogenous construct on the endogenous construct in the research model at a significance level of 0.05. Other than that, the p-value computed less than 0.05 or the t-statistic value computed is over 1.96 indicates a significant effect of an exogenous construct on the endogenous construct in the research model at 0.05 level of significance.

Then, the coefficient of determination (R-squared value) is used to measure the proportion of the variance in an endogenous latent construct that is explained by its exogenous constructs in the research model. Indeed, a higher R-squared value indicates that the model has greater explanatory power. An R-squared value of 0.75, 0.50, and 0.25 indicates a substantial, moderate, and weak level of the explanatory power of all the exogenous constructs on an endogenous construct on the research model respectively (Hair et al., 2019). Besides, Q-squared values measure the accuracy of predictions by comparing the predicted values to the actual values. The higher the Q-squared value, the greater the prediction accuracy. Q-squared values for all the endogenous constructs in the research model are suggested to be above 0, which indicates the research path model is predictive of relevance (Hair et al., 2019).

The PLS Predict approach can be used to evaluate the model's predictive power. This approach employs a k-fold cross-validation process. The root means square standardized error (RMSE) computed from PLS is compared with the one from the suggested naive linear regression (LM) benchmark. The RMSE is used to assess the non-symmetric distribution of the prediction error. If the minority of dependent construct indicators produce lower RMSE values compared to the naïve LM benchmark, it indicates the model has high predictive power (Hair et al., 2019).

The assessment of the mediating effect among latent constructs in the research model involves analyzing both direct and indirect effects among the constructs to identify the

potential mediating effects. If the indirect effect is statistically significant, it indicates the presence of mediation in the structural model. To further confirm the presence of mediating effects, the value accounted for (VAF) is computed by dividing the indirect effect by the total effect. A value of less than 0.2, 0.2 to 0.8 and above 0.8 indicates no mediation, partial mediation and full mediation in the research structural model analyzed (Abdullahi et al., 2022).

CHAPTER 4

RESULTS AND DISCUSSION

Chapter 4 presents the respondents' demographic information, research findings and their discussions.

4.1 Descriptive statistics

Table 4.1: Respondents' demographic information

Respondent's Profile	Categories	Frequency	Sample (%)
Gender	Male	129	56.10
	Female	101	43.90
Faculty	FSC	47	20.40
	FEGT	6	2.60
	FBF	89	38.70
	FICT	84	36.50
	FAS	4	1.70

In the research fieldwork conducted, a total of 230 respondents were involved. As summarized in Table 4.1, 129 (56.10%) were male respondents, while the remaining were females. 20.40%, 2.60%, 38.7%, 36.50%, and 1.70% of research sample tertiary learners

were from the Faculty of Science (FSC), Faculty of Engineering and Green Technology (FEGT), Faculty of Business and Finance (FBF), Faculty of Information and Communication Technology (FICT) and Faculty Arts and Social Science (FAS) respectively.

4.2 Evaluation on research reflective measurement model

Based on the results generated from SmartPLS 4.0, the evaluation on the research measurement model indicates that it aligns well with the needed requirements for internal consistency and reliability of the indicators, and convergent validity among indicators in all the latent constructs in the research theoretical framework.

Table 4.2.1 Indicators' loadings and constructs' internal reliability for Individual Performance-Related Variables

Construct	Loading	Cronbach's Alpha	ρ_A	CRI	AVE
<p><u>Knowledge Base of Subject Matter (KB)</u></p> <p>KB1. I update knowledge of subject matter in my field of study over times.</p> <p>KB2. I use various ways and strategies to develop my understanding of subject matter in my field of study.</p> <p>KB3. I follow recent developments and applications of subject matter in my field of study.</p> <p>KB4. I access up-to-date resources (such as books and journals) of the subject matter in my field of study.</p>	<p>0.860*</p> <p>0.865*</p> <p>0.873*</p> <p>0.716*</p>	0.849	0.864	0.899	0.691
<p><u>Critical Thinking Skills (CTS)</u></p> <p>CTS1. I open for ideas that challenge my held beliefs.</p> <p>CTS2. I consider various arguments to formulate my own point of view.</p> <p>CTS3. I justify my choices/ points of view made.</p>	<p>0.775*</p> <p>0.801*</p> <p>0.834*</p>	0.838	0.842	0.885	0.608

CTS4. I suggest new related points / ideas / inputs to the discussion.	0.769*				
CTS5. I put the discussion into a new perspective .	0.713*				
<u>Communication Skills (CMS)</u>		0.853	0.854	0.901	0.694
CMS1. I make appropriate comments to a situation/matter that has been raised up in the discussion.	0.804*				
CMS2. I express my idea clearly to others.	0.855*				
CMS3. I get what I want from interactions with peoples.	0.847*				
CMS4. I acknowledge and understand the message raised during the discussion.	0.826*				
<u>Collaboration Skills (CLS)</u>		0.900	0.899	0.926	0.715
CLS1. I complete an assigned task via team effort .	0.836*				
CLS2. I ensure each team member has his/her contribution to the assigned task.	0.864*				
CLS3. I share resources, information and work-related knowledge among team members in completing the assigned task.	0.857*				
CLS4. I coordinate with team members to achieve a common goal .	0.882*				

CLS5. I make decision in an assigned task with mutual respect among team members involved.	0.784*				
<u>Problem Solving Skills (PSS)</u>		0.879	0.881	0.912	0.675
PSS1. I manage to solve most problems even though initially no solution is immediately apparent.	0.771*				
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 .	0.814*				
PSS3. I think of alternatives to solve a problem.	0.850*				
PSS4. I decide and implement the best solution based on the available resources.	0.853*				
PSS5. I evaluate the effectiveness of the implemented solution to the problem.	0.819*				
<u>Information Literacy Skill (ILS)</u>		0.883	0.887	0.914	0.681
ILS1. I recognize information needed in my academic learning.	0.807*				
ILS2. I locate sources of needed information using information tools (such as searching engines and online databases).	0.807*				
ILS3. I evaluate validity of acquired information critically.	0.847*				

ILS4. I apply the acquired information to create knowledge in my area of study.	0.857*				
ILS5. I use the acquired information ethically and lawfully .	0.807*				
<u>Effective usage (EU) of ChatGPT</u>		0.928	0.928	0.954	0.874
EU1. Using ChatGPT fulfills my learning needs and requirements .	0.926*				
EU2. Using ChatGPT improves my overall academic performance .	0.947*				
EU3. Using ChatGPT meets my academic learning expectations .	0.931*				
Notes: * For $n = 5000$, $p\text{ value} < 0.05$; ρ_A = Dijkstra-Henseler's rho; CRI= Composite Reliability Index; AVE= Average Variance Extracted.					

Table 4.2.2 Indicators' loadings and constructs' internal reliability for Technological Performance-Related Variables

Construct	Loading	Cronbach's Alpha	ρ_A	CRI	AVE
<p><u>Learner's Job Expectancy on ChatGPT (JE)</u></p> <p>JE1. Using ChatGPT, I expect to perform better in my academic assessments (such as assignments and projects).</p> <p>JE2. Using ChatGPT, I expect to learn more about subject matter in my field of study.</p> <p>JE3. Using ChatGPT, I expect to improve time and effort efficiency in my academic learning.</p>	<p>0.873*</p> <p>0.912*</p> <p>0.898*</p>	0.875	0.880	0.923	0.800
<p><u>Perceived Usefulness and Importance (PUI) of ChatGPT</u></p> <p>PUI1. I believe ChatGPT is useful to support my academic learning.</p> <p>PUI2. I believe ChatGPT is valuable to support my academic learning.</p>	<p>0.941*</p> <p>0.953*</p> <p>0.931*</p>	0.936	0.937	0.959	0.887

PUI3. I believe ChatGPT is important to support my academic learning.					
<u>Behavioural Intention to use (BIU) ChatGPT</u> BIU1. I intend to use ChatGPT in my academic learning. BIU2. I predict I would use ChatGPT in my academic learning. BIU3. I plan to use ChatGPT in my academic learning.	0.926* 0.929* 0.933*	0.921	0.921	0.950	0.864
<u>Perceived Ease of Use (PEU) of ChatGPT</u> PEU1. As an end user, I find it is easy to use ChatGPT to do what I what it to do. PEU2. As the end user, I believe interacting with ChatGPT does not require a lot of my mental effort . PEU3. As an end user, I perceive that using ChatGPT does not need to refer the user manual/help guide provided.	0.901* 0.903* 0.831*	0.853	0.876	0.910	0.772
<u>Learner's Self-Efficacy (SE) to use ChatGPT</u>		0.918	0.919	0.942	0.803

SE1. I feel confident in my ability to use ChatGPT for my academic learning.	0.873*				
SE2. I feel I am on the top of things (or in full control) when I use ChatGPT for my academic learning.	0.908*				
SE3. I feel that things are going on the way I want to when I use ChatGPT for my academic learning.	0.908*				
Seff4. I am certain that I can use ChatGPT effectively for my academic learning.	0.894*				
<u>Effective usage (EU) of ChatGPT</u>		0.928	0.928	0.954	0.874
EU1. Using ChatGPT fulfills my learning needs and requirements .	0.926*				
EU2. Using ChatGPT improves my overall academic performance .	0.947*				
EU3. Using ChatGPT meets my academic learning expectations .	0.931*				
Notes: * For $n = 5000$, $p \text{ value} < 0.05$; $\rho_A =$ Dijkstra-Henseler's rho; CRI= Composite Reliability Index; AVE= Average Variance Extracted.					

Referring to Table 4.2.1 and Table 4.2.2, the indicators for all constructs in the research theoretical model are reliable measures of their respective latent constructs as their loading values are above 0.708. Besides, the high level of internal consistency and reliability of the indicators in their respective constructs are justified since the composite reliability, Cronbach's alpha, and Dijkstra-Henseler's rho (ρ_A) values for all the constructs are above 0.70. As the Average Variance Extracted (AVE) values for all the constructs are above 0.50, it implies acceptable convergent validity of the latent constructs by their respective indicators.

Table 4.2.3: Fornell-Larcker Criterion.

Latent Construct	BIU	CLS	CMS	CTS	EU	ILS	JE	KB	PEU	PSS	PUI	SE
Behavioural Intention to Use (BIU)	0.929											
Collaboration Skills (CLS)	0.447	0.845										
Communication Skills (CMS)	0.389	0.696	0.833									
Critical Thinking Skills (CTS)	0.434	0.726	0.749	0.780								
Effective usage of ChatGPT(EU)	0.780	0.349	0.424	0.415	0.935							
Information Literacy Skills (ILS)	0.399	0.735	0.716	0.677	0.350	0.825						
Learner's Job Expectancy for ChatGPT(JE)	0.717	0.444	0.428	0.484	0.711	0.446	0.894					
Knowledge Base of Subject Matter (KB)	0.327	0.501	0.626	0.563	0.294	0.524	0.370	0.831				
Perceived Ease of Use (PEU)	0.782	0.389	0.366	0.424	0.712	0.297	0.637	0.297	0.879			
Problem Solving Skills (PSS)	0.448	0.797	0.773	0.692	0.397	0.791	0.540	0.578	0.388	0.822		
Perceived Usefulness and Importance (PUI)	0.845	0.395	0.383	0.421	0.784	0.361	0.773	0.296	0.767	0.425	0.942	
Learner's Self-Efficacy to use ChatGPT(SE)	0.773	0.319	0.355	0.358	0.847	0.309	0.584	0.268	0.761	0.358	0.745	0.896

The Fornell-Larcker criterion compares the square of the correlation coefficients among all constructs with the average variance extracted (AVE) of each construct in the research theoretical framework. As shown in Table 4.2.3, as AVE values of each construct are higher than all the squared correlation coefficients between the construct and other constructs, discriminant validity among all constructs in the research theoretical framework is justified.

4.3 Structural model evaluation

After the measurement model are evaluated and the result does not involved any issue related to the needed requirements for internal consistency and reliability of the indicators, discriminant and convergent validity among indicators from their related constructs in the research theoretical model, the structural model among all constructs in the research theoretical framework is assessed.

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

Latent Construct	BIU	CLS	CMS	CTS	EU	ILS	JE	PSS	PUI	SE
Behavioural Intention to Use (BIU)	-	-	-	-	3.443	-	-	-	-	-
Collaboration Skills (CLS)	-	-	2.267	-	-	2.170	-	-	-	-
Communication Skills (CMS)	-	-	-	-	3.563	-	-	-	-	-
Critical Thinking Skills (CTS)	-	-	-	-	2.702	2.381	-	2.074	-	-
Information Literacy Skills (ILS)	-	-	-	-	-	-	-	-	-	-
Learner's Job Expectancy for ChatGPT (JE)	-	-	2.342	-	3.012	-	-	1.953	-	-
Knowledge Base of Subject Matter (KB)	2.515	-	-	-	2.395	-	-	-	-	2.483
Perceived Ease of Use (PEU)	-	1.000	1.436	1.000	1.748	1.504	-	1.550	-	-
Problem Solving Skills (PSS)	3.060	-	-	-	-	-	-	-	1.000	-
Perceived Usefulness and Importance (PUI)	-	-	-	-	3.909	-	-	-	-	-
Learner's Self-Efficacy to use ChatGPT (SE)	4.107	-	-	-	-	-	1.000	-	-	2.483

The collinearity among the exogenous constructs in the research theoretical framework is evaluated by the variance inflation factor (VIF). As indicated in Table 4.3.1, all VIF values for the constructs are between 1 and 5. This implies that there is no occurrence of major collinearity problems among exogenous constructs in the research model.

Table 4.3.2: p values, t-statistics, 95 percentile bootstrap confidence intervals (CIs) involving individual performance-related variables.

Hypothesis	P value	t statistic	95 percentile Bootstrap CI	Supported
H_{a1}: KB→EU	0.331	0.971	[-0.123,0.042]	No
H_{a2}: KB→CLS	0.000	8.435	[0.381,0.617]	Yes
H_{a3}: KB→CMS	0.000	5.613	[0.192,0.401]	Yes
H_{a4}: KB→CTS	0.000	9.768	[0.443,0.673]	Yes
H_{a5}: KB→ILS	0.012	2.524	[0.028,0.253]	Yes
H_{a6}: KB→PSS	0.002	3.156	[0.056,0.254]	Yes
H_{a7}: CMS→EU	0.012	2.509	[0.045,0.332]	Yes
H_{a8}: CLS→CMS	0.001	3.467	[0.130,0.461]	Yes
H_{a9}: CLS→ILS	0.000	6.284	[0.331,0.638]	Yes
H_{a10}: CTS→EU	0.943	0.071	[-0.111,0.097]	No
H_{a11}: CTS→ILS	0.001	3.465	[0.103,0.381]	Yes
H_{a12}: CTS→PSS	0.000	3.823	[0.115,0.349]	Yes
H_{a13}: ILS→EU	0.799	0.255	[-0.135,0.109]	No
H_{a14}: ILS→CMS	0.000	3.686	[0.161,0.523]	Yes
H_{a15}: ILS→PSS	0.000	8.861	[0.427,0.677]	Yes
H_{a16}: PSS→EU	0.042	2.035	[-0.265,-0.011]	Yes

Table 4.3.3: p values, t-statistics, 95 percentile bootstrap confidence intervals (CIs) involving technological performance-related variables.

Hypothesis	P value	t statistic	95 percentile Bootstrap CI	Supported
H_{a18}: JE → EU	0.000	5.724	[0.199,0.404]	Yes
H_{a19}: JE → SE	0.822	0.225	[-0.139,0.199]	No
H_{a20}: SE → EU	0.000	8.413	[0.428,0.692]	Yes
H_{a21}: SE → BIU	0.000	3.709	[0.116,0.359]	Yes
H_{a22}: BIU → EU	0.050	1.963	[0.002,0.274]	Yes
H_{a23}: JE → BIU	0.034	2.120	[0.011,0.258]	Yes
H_{a24}: PEU → BIU	0.004	2.892	[0.074,0.349]	Yes
H_{a25}: PEU → PUI	0.000	21.001	[0.689,0.834]	Yes
H_{a26}: PUI → BIU	0.000	5.071	[0.245,0.569]	Yes
H_{a27}: PUI → JE	0.000	21.606	[0.699,0.839]	Yes
H_{a28}: PUI → SE	0.000	9.108	[0.560,0.872]	Yes

From the research results summarized in Table 4.3.2, we can separate the result into two parts which are learner's individual performance-related variables and technological performance-related variables.

Referring to table 4.3.2, there is sufficient evidence to conclude that effective usage of ChatGPT in learner's academic learning is significantly influenced by tertiary learners' communication and problem solving skills. Moreover, tertiary learner's information literacy skills are significantly influencing both their communication and problem solving skills. Additionally, tertiary learners' collaboration skills have a significant effect on their information literacy and communication skills. Furthermore, tertiary learners' critical thinking skills also have a significant influence on their information literacy and problem solving skills. Finally, the tertiary learners' knowledge base of subject matter has significant affect to all 21st century skills outlined in this research framework, namely critical thinking skills, collaboration skills, information literacy skills, communication skills and problem solving skills.

As summarized in table 4.3.3, there is sufficient evidence to conclude that tertiary learners' job expectancy, self-efficacy, and behavioural intention to use ChatGPT have a significant influence on the effective usage of ChatGPT in their academic learning. Besides, tertiary learners' perceived ease of use of ChatGPT significantly affects their behavioural intention to use and perceived usefulness and importance of ChatGPT. In addition, tertiary learners' behavioural intention, self-efficacy to use ChatGPT and their job expectancy for ChatGPT are significantly influenced by their perceived usefulness and importance of ChatGPT. Furthermore, tertiary learner's behavioural intention to use ChatGPT significantly influenced by tertiary learners' self-efficacy and job expectancy for ChatGPT.

Table 4.3.4: Mediating Effects involving individual performance-related variables.

Mediating Effect		p-value	$VAF = \frac{Indirect\ effect}{total\ effect}$	Supported
H_{a17}: The relationship between CTS and PSS skills is mediated by ILS.				Yes
Direct Effect	CTS→PSS	0.000	=0.134/0.362	
	CTS→ILS	0.001	=0.419	
	ILS→PSS	0.000		
Indirect Effect	CTS→ILS→PSS	0.000		

As indicated in Table 4.3.4, the information literacy skills mediate the relationship between critical thinking skills and problem solving skills of learners to use ChatGPT in their academic learning. As the VAF value is 41.9%, which is in between 20% and 80%, indicates it's a partial mediation (Hadi et al.,2016).

Table 4.3.5: Mediating Effects involving technological performance-related variables.

Mediating Effect		p-value	$VAF = \frac{Indirect\ effect}{total\ effect}$	Supported
H_{a29}: The relationship between PEU and BIU is mediated by PUI.				Yes
Direct Effect	PEU→ BIU	0.000	=0.314/0.732	
	PEU→ PUI	0.000	=0.429	
	PUI→ BIU	0.000		
Indirect Effect	PEU→ PUI→ BIU	0.000		

As shown in Table 4.3.5, tertiary learners' perceived usefulness and importance play a significant mediating role in the relationship between their perceived ease of use and behavioural intention to use ChatGPT in their academic learning. Since the value accounted for (VAF) the mediation effect is 0.429, learners' perceived usefulness and importance is a partial mediator in the relationship stated above (Hadi et al., 2016).

Table 4.3.6: R-squared and Q-squared values.

Construct	R-square	R-square adjusted	Q²
BIU	0.783	0.779	0.605
CLS	0.251	0.247	0.239
CMS	0.637	0.632	0.382
CTS	0.317	0.314	0.303
EU	0.805	0.798	0.486
ILS	0.598	0.592	0.260
JE	0.597	0.595	0.398
PSS	0.688	0.684	0.323
PUI	0.588	0.586	0.584
SE	0.555	0.551	0.538

The coefficient of determination (R-squared value) measures the proportion of the variance in an endogenous latent construct that is explained by its exogenous constructs in the

research model. Higher R-squared values indicate greater explanatory power. Table 4.3.6 shows that the research theoretical framework explains 80.5% and 78.3% of the variance in tertiary learners' effective usage and behavioural intention to use ChatGPT respectively, which indicate a high degree of explanatory power.

Besides, in the individual performance-related variables, the problem solving skills, communication skills, and information literacy skills have moderate explanatory power as they have R-squared values of 0.688, 0.637, and 0.598 respectively. Furthermore, in the technological performance-related variables, learners' job expectancy for ChatGPT, perceived usefulness and importance, and self-efficacy also have moderate explanatory power by their respective exogenous constructs in the research model as they have R-squared values of 0.597, 0.588, and 0.555 respectively. Moreover, the critical thinking skills and collaboration skills have weak explanatory power as they have R-square values of 0.317 and 0.251 respectively.

Q-squared value computed provides information about the research model's ability to predict its endogenous latent constructs in the research model out of samples collected in the research fieldwork. Referring to Table 4.3.7, as Q-squared values for all the endogenous

constructs in the research model are above 0, the research path model is predictive relevance.

Table 4.3.7: PLS Predict.

Construct	Q ² predict	PLS-SEM_RMSE	PLS-SEM_MAE	LM_RMSE	LM_MAE
BIU1	0.516	0.985	0.748	0.989	0.726
BIU2	0.506	1.023	0.743	1.010	0.692
BIU3	0.539	1.009	0.767	0.940	0.685
CLS1	0.181	1.169	0.909	1.138	0.883
CLS2	0.142	1.253	0.971	1.206	0.927
CLS3	0.156	1.167	0.887	1.177	0.880
CLS4	0.166	1.121	0.872	1.131	0.877
CLS5	0.197	1.136	0.908	1.156	0.901
CMS1	0.254	1.013	0.778	1.035	0.792
CMS2	0.239	1.010	0.772	1.022	0.781
CMS3	0.308	0.981	0.736	0.993	0.742
CMS4	0.251	1.028	0.796	1.021	0.779
CTS1	0.144	1.146	0.846	1.151	0.855
CTS2	0.130	1.086	0.822	1.068	0.810
CTS3	0.251	1.021	0.793	0.980	0.732

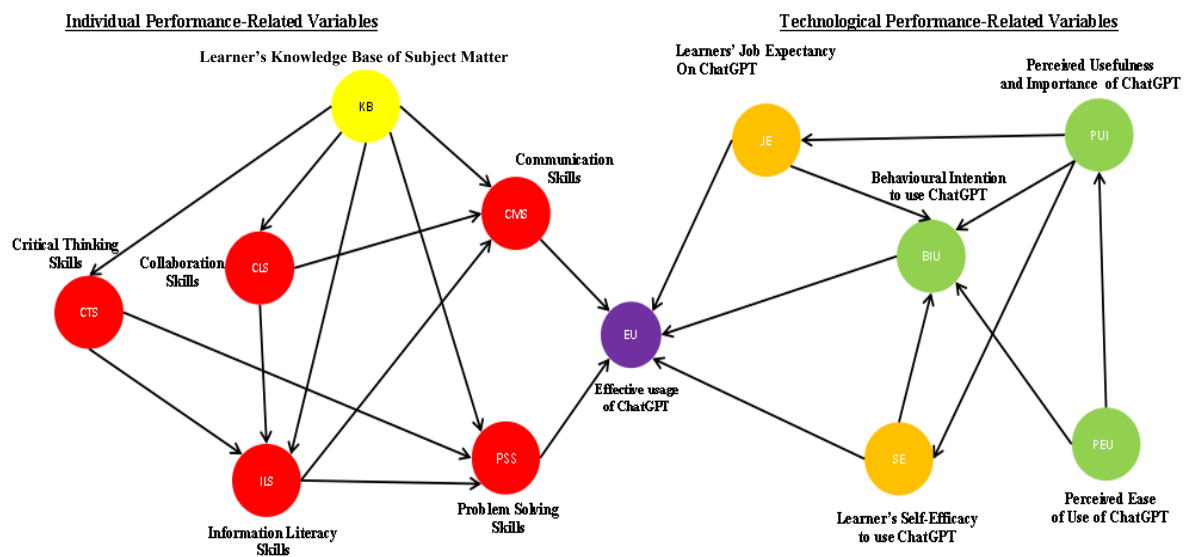
CTS4	0.130	1.127	0.853	1.058	0.800
CTS5	0.247	0.969	0.754	0.993	0.769
EU1	0.415	1.097	0.811	1.124	0.796
EU2	0.414	1.080	0.841	1.078	0.808
EU3	0.437	0.996	0.773	0.997	0.727
ILS1	0.211	1.088	0.848	1.052	0.799
ILS2	0.119	1.129	0.852	1.128	0.850
ILS3	0.196	1.048	0.834	1.086	0.844
ILS4	0.236	0.980	0.766	1.016	0.775
ILS5	0.111	1.194	0.938	1.201	0.950
JE1	0.260	1.261	0.919	1.291	0.929
JE2	0.300	1.145	0.873	1.129	0.833
JE3	0.385	1.133	0.887	1.112	0.838
PSS1	0.273	1.027	0.763	1.043	0.772
PSS2	0.161	1.061	0.851	1.039	0.825
PSS3	0.222	1.017	0.817	1.022	0.804
PSS4	0.201	1.077	0.853	1.105	0.872
PSS5	0.226	1.134	0.878	1.151	0.887
PUI1	0.468	1.072	0.802	1.078	0.784
PUI2	0.526	0.997	0.748	0.983	0.715

PUI3	0.554	0.981	0.744	1.011	0.751
SE1	0.427	1.102	0.814	1.090	0.748
SE2	0.361	1.173	0.883	1.216	0.897
SE3	0.451	1.059	0.799	1.064	0.798
SE4	0.474	1.040	0.803	1.035	0.740

The predictive power of a model can also be assessed through PLS Predict approach in SmartPLS 4. According to Table 4.3.7, all the values Q-squared predicted are greater than zero. This indicates that the predictions perform better than the most naïve benchmarked. Furthermore, the root mean square standardized error (RMSE) computed from PLS is compared with the one from the suggested naïve linear regression benchmarked (LM). From Table 4.3.7, the results show that 23 out of 40 dependent construct indicators produce lower RMSE values compared to the naïve benchmarked. As the minority of the dependent construct indicators in the PLS-SEM analysis produce higher prediction errors, indicates that the model has a medium predictive power.

4.4 Discussion

Figure 4.4: Summary of the research findings



The significant research results are summarized in Figure 4.4. In the individual performance-related variables, the effective usage of ChatGPT among tertiary learners in their academic learning is significantly influenced by both of their communication and problem solving skills. This result is consistent with the research findings by Iñiguez-

Berrozpe (2020), Yunu et al. (2021), Maican et al. (2019) and Gilakjani (2017). Communication skills are required for learners to interact with ChatGPT effectively as communication skills help the learners to express their ideas clearly via interface provided by ChatGPT. Meanwhile, strong problem solving skills enable learners to analyze information retrieved from ChatGPT and integrate it into their academic tasks effectively.

Besides, tertiary learner's information literacy skills are shown to have significantly influence on both their communication and problem solving skills. This result is aligned with the research efforts carried out by Cardoso et al. (2018), Bruce (2002), Kennedy et al (2020) and Baji et al. (2018). A learner's proficiency in information literacy skills encompasses the ability to evaluate, interpret, and effectively utilize the information from ChatGPT. At the same time, tertiary learners' information literacy skills enhance their ability to identify and address problems faced in their academic learning. Both information literacy and problem solving skills enable tertiary learners to deal with complex problems more effectively using ChatGPT.

In addition, tertiary learners' collaboration skills have a significant effect on their communication and information literacy skills. This result is consistent with the research findings by Patel et al. (2012), Kusmiarti et al. (2020), Wallace (2021) and Nayda et al. (2008). When learners possess strong collaboration skills, they can engage in collaborative learning environments where they can involve themselves in the discussion and communicate with others more confidently for their academic tasks with the usage of

ChatGPT. Furthermore, collaboration skills enable learners to combine the knowledge gained from discussion with others, and then improve their ability to evaluate and utilize it by using ChatGPT.

On top of it, tertiary learners' critical thinking skills also significantly influenced their information literacy and problem solving skills. These research outcomes are consistent with research findings by Albitz (2007) and Yu, et al. (2015). When learners have strong critical thinking skills, they can effectively assess the information needed for their academic tasks with the help of ChatGPT. Critical thinking skills also foster a deep understanding of information and enhance tertiary learners' problem solving abilities by enabling them to approach academic challenges when they use ChatGPT.

Lastly, the learner's knowledge base of subject matter has a significant effect on all 21st century skills outlined in the research framework, namely critical thinking skills, collaboration skills, information literacy skills, communication skills, and problem solving skills. These results are consistent with the research efforts done by Nokes-Malach et al. (2012), Wu et al. (2007), Hakim et al. (2018), Walton et al. (2004) and Komarudin et al. (2020). Tertiary learners' 21st century skills rely on a strong foundation of their knowledge base of subject matter, as the knowledge base facilitate the execution of their 21st century skills to face challenges in their academic learning.

By analyzing technological performance-related variables, there is sufficient evidence to conclude that tertiary learners' job expectancy, self-efficacy and behavioural intention to use ChatGPT have a significant influence on its effective usage in their academic learning. These findings align with the existing literature that effective usage of technology is influenced by end users' job expectancy (Sang, 2018; Shahsavar et al., 2023), self-efficacy (Celik et al., 2013, Renn, 2001), and behavioural intention (Venkatesh et al., 2003; Chen et al., 2011). Tertiary learners' expectations of performing better academically, learning more about their subject matter, and improving learning efficiency while using ChatGPT facilitate the effective usage of ChatGPT in their academic learning. In addition, tertiary learners' confidence and belief in their capabilities to leverage ChatGPT enable them to use ChatGPT effectively in their academic learning. Furthermore, when learners have a stronger intention to use ChatGPT, they are more likely to adopt and integrate it effectively into their academic learning.

Besides, tertiary learners' perceived ease of use of ChatGPT significantly affects their behavioural intention to use and perceived usefulness and importance of ChatGPT. These research results are consistent with past similar studies (Venkatesh et al., 2000; Baharin et al., 2015). When tertiary learners perceive ChatGPT as user-friendly, they not only comfortably recognize the useful and important utilities of ChatGPT, but also enhance the behavioural intention to use ChatGPT in academic learning. On the other hand, relationship between tertiary learners' perceived ease of use and behavioural intention to use ChatGPT is partially mediated by their perceived usefulness and importance of a technology. This

research result is consistent with the finding by Venkatesh and Davis (2000). Tertiary learners' perceived ease of use of ChatGPT directly influences their behavioural intention to use ChatGPT. At the same time, tertiary learners have higher intention to use ChatGPT if they also recognize the value and importance of ChatGPT in their academic learning.

Besides, tertiary learners' behavioural intention, self-efficacy to use ChatGPT and job expectancy for ChatGPT are significantly influenced by their perceived usefulness and importance of ChatGPT. These findings are consistent with the research results in the adaptation of 4th Industry Revolution driven technologies (Yeoh et al., 2023). Tertiary learners' perceived usefulness and importance of ChatGPT is expected to motivate them to better understand the utilities and functionalities of ChatGPT. As a result, tertiary learners are more confident in managing the usage of ChatGPT in their academic learning (Rahmawati et al., 2019). Furthermore, tertiary learners who perceive ChatGPT as a valuable learning tool tend to recognize the positive outcomes of using it and enhance their intention to use it. On top of it, tertiary learners' behavioural intention to use ChatGPT significantly affects their self-efficacy to use it. Tertiary learners' behavioural intention to use ChatGPT reflects their levels of acceptance of ChatGPT. Once there is a high acceptance level of ChatGPT, tertiary learners are expected to have more confidence to leverage ChatGPT effectively in their academic learning.

Lastly, tertiary learners' behavioural intention to use ChatGPT is significantly influenced by their self-efficacy and job expectancy for ChatGPT. This is consistent with the research conducted by De Vries et al. (1988), Ariff et al. (2012), Chen et al. (2011) and Nikou et al.

(2017). When learners have high self-efficacy and positive job expectancy for ChatGPT, they are more likely to adopt it as a valuable tool in their academic learning.

CHAPTER 5

CONCLUSION

Chapter 5 outlines the conclusion and provides a summary of the research results. These research findings enable UTAR undergraduates to gain further insight on how to use ChatGPT effectively for their academic learning purposes. Besides, the research findings can be used as a term of reference for the stakeholders at UTAR Kampar Campus to facilitate and manage the usage of ChatGPT as a learning tool in the tertiary educational institution. This chapter ends with the recommendations to the research stakeholders and future research.

This research aims to analyze the inter-relationships among individual and technological performance-related variables, and their impacts on the effective usage of ChatGPT in academic learning among tertiary learners. Individual performance-related variables analyzed in the research are tertiary learners' knowledge base of subject matter, critical thinking skills, communication skills, collaboration skills, problem solving skills, and information literacy skills. On the other hand, technological performance-related variables involved in this research are tertiary learners' technological job expectancy, self-efficacy, and acceptance level while using ChatGPT.

5.1 Summary on research results

In relation to individual performance-related variables, the research results conclude that the effective usage of ChatGPT in academic learning is influenced by tertiary learners' communication and problem solving skills. Moreover, tertiary learner's information literacy skills play a crucial role in enhancing both their communication and problem solving skills. Furthermore, tertiary learners' critical thinking skills also have a significant influence on their information literacy and problem solving skills. Additionally, tertiary learners' collaboration skills have a significant effect on their information literacy and communication skills. On top of it, the learners' knowledge base of subject matter has significant effect on all 21st century skills analyzed in this research theoretical framework, namely critical thinking skills, collaboration skills, information literacy skills,

communication skills and problem solving skills. Lastly, information literacy skills serve as a mediator in the relationship between learners' critical thinking abilities and their problem-solving skills when utilizing ChatGPT in academic learning.

From the technological performance-related variables studied, tertiary learners' job expectancy on the outcomes of using ChatCPT, self-efficacy and behavioural intention to use ChatGPT significantly affect its effective usage in their academic learning. Besides, both tertiary learners' self-efficacy and job expectancy when using ChatGPT are significantly affected by their perceived usefulness and importance of ChatGPT. In addition, tertiary learners' self-efficacy and job expectancy in ChatGPT are also significantly influenced their behavioural intention to use it. Furthermore, the relationship between tertiary learners' perceived ease of use and their behavioral intention to use ChatGPT is partially mediated by their perceived usefulness and importance of ChatGPT.

5.2 Recommendations to UTAR Kampar Campus's stakeholders

According to the research findings, all the UTAR Kampar undergraduates can gain useful insights into the specific skills that are outlined in this research which are essential for successful utilization of ChatGPT. By understanding the importance of these skills, tertiary learners can focus on developing them to maximize the benefits of using ChatGPT as a learning tool. Besides, as the knowledge base of subject matter influences all the studied

21st century skills, tertiary learners should also deepen their understanding on their subject matter over times to strengthen this skill set in facing challenges in their academic learning.

Besides, UTAR Kampar management can use the findings as a basis for developing policies and guidelines that facilitate and regulate the usage of ChatGPT among its tertiary learners in their academic learning. For example, UTAR management can initiate related training programs and workshops to help educators and students with the necessary skills and knowledge to utilize ChatGPT effectively. In addition, educators can utilize plagiarism or AI detectors to maintain academic integrity and ensure that learners are engaging with the subject matter in an ethical and responsible manner.

5.3 Recommendations for future research

The current research findings are currently generalized to the specific target population of undergraduates at UTAR Kampar campus. It is recommended the research fieldwork to be extended to undergraduates from UTAR Sungai Long Campus as well as other private and public universities in Malaysia so that the research findings can offer insight that better reflects the perspectives of undergraduates from all tertiary institutions in Malaysia.

Besides, the contributing factors identified in this study primarily are based on current literature. As ChatGPT evolves, more new features and capabilities are to be introduced. Consequently, future research may need to further explore and expand the individual and technological performance-related variables studied over times.

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Appendix A

Questionnaire Survey



UNIVERSITI TUNKU ABDUL RAHMAN

QUESTIONNAIRE

TITLE OF THE RESEARCH PROJECT:

Exploring Factors and Their Inter-relationship Toward the Effective Usage of ChatGPT in the Academic Learning among UTAR Kampar Undergraduates

Dear respondent,

I am Year 3 Semester 1 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 exploring factors and their inter-relationship toward the effective usage of ChatGPT in the academic learning among UTAR Kampar Undergraduates.

This questionnaire consists of four sections (Section A to Section D). Your cooperation to answer this questionnaire is much significant in helping me to complete my research. I appreciate your time in completing these questions. All of the information obtained with regards 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.

Compliance to the Personal Data Protection Act 2010 (“PDPA”)

This is a Privacy Notice and shall govern UTAR in dealing with protection of personal data. To protect personal data, the Notice may be changed from time to time. Personal Data Protection Act 2010 (“PDPA”) came into force on 15 November 2013, therefore Universiti Tunku Abdul Rahman (“UTAR”) is hereby bound to make notice and require consent in relation to collection, recording, storage, usage and retention of personal data. Please visit https://www2.utar.edu.my/PrivacyNotice_English.jsp to view our Privacy Notice. By ticking the checkbox below, and submitting or providing your personal data to UTAR, you had consented and agreed for your personal data to be used in accordance to the terms and condition in the Notice and our relevant policy.

You may access and update your personal data by writing to us at **yapzhihui1166@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.

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 and above

Section B: Learner’s Individual Performance-Related Variables

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

<i>Number</i>	<i>Descriptor</i>
7	Always
6	Very frequently
5	Frequently
4	Sometimes
3	Rarely
2	Very rarely
1	Never

Knowledge Base of Subject Matter		Always -----Never						
1.	I update knowledge of subject matter in my field of study over times .	7	6	5	4	3	2	1
2.	I use various ways and strategies to develop my understanding of subject matter in my field of study.	7	6	5	4	3	2	1
3.	I follow recent developments and applications of subject matter in my field of study.	7	6	5	4	3	2	1
4.	I access up-to-date resources (such as books and journals) of the subject matter in my field of study.	7	6	5	4	3	2	1

Skills Set

Critical Thinking Skills (CTS)		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 choices/ points of view made.	7	6	5	4	3	2	1
4.	I suggest new related points / ideas / inputs to the discussion.	7	6	5	4	3	2	1
5.	I put the discussion into a new perspective .	7	6	5	4	3	2	1
Communication Skills(CMS)		Always ----- Never						

1.	I make appropriate comments to a situation/matter that has been raised up in the discussion.	7	6	5	4	3	2	1
2.	I express my idea clearly to others.	7	6	5	4	3	2	1
3.	I get what I want from interactions with peoples.	7	6	5	4	3	2	1
4.	I acknowledge and understand the message raised during the discussion.	7	6	5	4	3	2	1
Collaboration Skills (CLS)		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
Problem Solving Skills (PSS)		Always ----- Never						
1.	I manage to solve most problems even though initially no solution is immediately apparent.	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 think of alternatives to solve a problem.	7	6	5	4	3	2	1
4.	I decide and implement the best solution based on the available resources.	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

Information Literacy Skill (ILS)		Always ----- Never						
1.	I recognize information needed in my academic learning.	7	6	5	4	3	2	1
2.	I locate sources of needed information using information tools (such as searching engines and online databases)	7	6	5	4	3	2	1
3.	I evaluate validity of acquired information critically.	7	6	5	4	3	2	1
4.	I apply the acquired information to create knowledge in my area of study.	7	6	5	4	3	2	1
5.	I use the acquired information ethically and lawfully .	7	6	5	4	3	2	1

Section C: Technological Performance-Related Variables

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

<i>Number</i>	<i>Descriptor</i>
7	Always
6	Very frequently
5	Frequently
4	Sometimes
3	Rarely
2	Very rarely
1	Never

Learner's Job Expectancy on ChatGPT(JE)		Always ----- Never						
1.	Using ChatGPT, I expect to perform better in my academic assessments (such as assignments and projects).	7	6	5	4	3	2	1

2.	Using ChatGPT, I expect to learn more about subject matter in my field of study.	7	6	5	4	3	2	1
3.	Using ChatGPT, I expect to improve time and effort efficiency in my academic learning.	7	6	5	4	3	2	1
Learner's Acceptance Level to ChatGPT(AL)		Always ----- Never						
Perceived Usefulness and Importance (PU)								
1.	I believe ChatGPT is useful to support my academic learning.	7	6	5	4	3	2	1
2.	I believe ChatGPT is valuable to support my academic learning.	7	6	5	4	3	2	1
3.	I believe ChatGPT is important to support my academic learning.	7	6	5	4	3	2	1
Behavioural Intention to use (BIU)								
1.	I intend to use ChatGPT in my academic learning.	7	6	5	4	3	2	1
2.	I predict I would use ChatGPT in my academic learning.	7	6	5	4	3	2	1
3.	I plan to use ChatGPT in my academic learning..	7	6	5	4	3	2	1
Perceived Ease of Use (PEU)								
1.	As an end user, I find it is easy to use ChatGPT to do what I what it to do.	7	6	5	4	3	2	1
2.	As the end user, I believe interacting with ChatGPT does not require a lot of my mental effort.	7	6	5	4	3	2	1
3.	As an end user, I perceive that using ChatGPT does not need to refer the user manual/help guide provided.	7	6	5	4	3	2	1
Learner's Self-Efficacy to use ChatGPT(SE)								
1.	I feel confident in my ability to use ChatGPT for my academic learning.	7	6	5	4	3	2	1
2.	I feel I am on the top of things (or in full control) when I use ChatGPT for my academic learning.	7	6	5	4	3	2	1

3.	I feel that things are going on the way I want to when I use ChatGPT for my academic learning.	7	6	5	4	3	2	1
4.	I am certain that I can use ChatGPT effectively for my academic learning.	7	6	5	4	3	2	1

Section D: Effective usage of ChatGPT

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

<i>Number</i>	<i>Descriptor</i>
7	Totally Agree
6	Very Agree
5	Agree
4	Neutral
3	Disagree
2	Very Disagree
1	Totally Disagree

Effective usage of ChatGPT(EU)		Totally Agree -----Totally Disagree						
1.	Using ChatGPT fulfills my learning needs and requirements.	7	6	5	4	3	2	1
2.	Using ChatGPT improves my overall academic performance.	7	6	5	4	3	2	1
3.	Using ChatGPT meets my academic learning expectations	7	6	5	4	3	2	1

Appendix B

Online Questionnaire Survey in Google Form

Exploring Factors and Their Inter-relationship Towards the Effective Usage of ChatGPT in the Academic Learning among UTAR Kampar Undergraduates

Dear respondent,

I am Year 3 Semester 1 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 **exploring factors and their inter-relationship towards the effective usage of ChatGPT in the academic learning among UTAR Kampar Undergraduates.**

This questionnaire consists of four **sections (Section A to Section D)**. Your cooperation to answer this questionnaire is much significant in helping me to complete my research. I appreciate your time in completing these questions. **All** of the information obtained with regards 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.

Compliance to the Personal Data Protection Act 2010 ("PDPA")

*

This is a Privacy Notice and shall govern UTAR in dealing with protection of personal data. To protect personal data, the Notice may be changed from time to time. Personal Data Protection Act 2010 ("PDPA") came into force on 15 November 2013, therefore Universiti Tunku Abdul Rahman ("UTAR") is hereby bound to make notice and require consent in relation to collection, recording, storage, usage and retention of personal data. Please visit https://www2.utar.edu.my/PrivacyNotice_English.jsp to view our Privacy Notice. By ticking the checkbox below, and submitting or providing your personal data to UTAR, you had consented and agreed for your personal data to be used in accordance to the terms and condition in the Notice and our relevant policy.

You may access and update your personal data by writing to us at yapzhihui1166@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.

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 and above

Section B: Learner's Individual Performance-Related Variables

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

<i>Number</i>	<i>Descriptor</i>
7	Always
6	Very frequently
5	Frequently
4	Sometimes
3	Rarely
2	Very rarely
1	Never

Knowledge Base of Subject Matter

1) I **update knowledge** of subject matter in my field of study **over times**. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

2) I use various **ways** and **strategies** to develop my understanding of subject matter in my field of study. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

3) I follow recent **developments** and **applications** of subject matter in my field of study. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

4) I **access up-to-date resources** (such as books and journals) of the subject matter in my field of study. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

Critical Thinking Skills (CTS)

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

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

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

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

3) I **justify** my choices/ points of view made. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

4) I **suggest new** related points / ideas / inputs to the discussion. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

5) I put the discussion into **a new perspective**. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

Communication Skills(CMS)

1) I **make appropriate comments** to a situation/matter that has been raised up in *
the discussion.

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

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

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

3) I **get what I want from interactions** with peoples. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

4) I **acknowledge and understand the message** raised during the discussion. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

Collaboration Skills (CLS)

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

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

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

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	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	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

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

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

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

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

Problem Solving Skills (PSS)

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

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	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	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

3) I think of **alternatives** to solve a problem. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

4) I **decide and implement the best solution** based on the available resources. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

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

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

Information Literacy Skill (ILS)

1) I **recognize information needed** in my academic learning. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

2) I **locate** sources of **needed information** using **information tools** (such as searching engines and online databases) *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

3) I **evaluate validity** of acquired information critically. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

4) I **apply** the acquired information to **create knowledge** in my area of study. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

5) I **use** the acquired information **ethically and lawfully**. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

Section C: Technological performance-related variables

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

<i>Number</i>	<i>Descriptor</i>
7	Always
6	Very frequently
5	Frequently
4	Sometimes
3	Rarely
2	Very rarely
1	Never

Learner's Job Expectancy on ChatGPT(JE)

1) Using ChatGPT, I **expect to perform better in my academic assessments** (such as assignments and projects). *

1 2 3 4 5 6 7

Never Always

2) Using ChatGPT, I **expect to learn more about subject matter** in my field of study. *

1 2 3 4 5 6 7

Never Always

3) Using ChatGPT, I **expect to improve time and effort efficiency** in my academic learning. *

1 2 3 4 5 6 7

Never Always

Perceived Usefulness and Importance (PUI)

1) I **believe** ChatGPT is **useful** to support my academic learning. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

2) I **believe** ChatGPT is **valuable** to support my academic learning. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

3) I **believe** ChatGPT is **important** to support my academic learning. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

Behavioural Intention to use (BIU)

1) I **intend** to use ChatGPT in my academic learning. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

2) I **predict** I would use ChatGPT in my academic learning. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

3) I **plan** to use ChatGPT in my academic learning. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

Perceived Ease of Use (PEU)

1) As an end user, I find it is **easy to use** ChatGPT to do what I what it to do. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

2) As the end user, I **believe** interacting with ChatGPT **does not require a lot of my mental effort**. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

3) As an end user, I perceive that using ChatGPT **does not need to refer** the user manual/help guide provided. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

Learner's Self-Efficacy to use ChatGPT(SE)

1) I feel **confident** in my ability to use ChatGPT for my academic learning. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

2) I feel I am on **the top of things** (or in full control) when I use ChatGPT for my academic learning. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

3) I feel that things are going on **the way I want** to when I use ChatGPT for my academic learning. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

4) I am **certain** that I can use ChatGPT **effectively** for my academic learning. *

	1	2	3	4	5	6	7	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Always

Section D: Effective usage of ChatGPT

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

<i>Number</i>	<i>Descriptor</i>
7	Totally Agree
6	Very Agree
5	Agree
4	Neutral
3	Disagree
2	Very Disagree
1	Totally Disagree

Effective usage of ChatGPT(EU)

1) Using ChatGPT **fulfills** my learning needs and requirements. *

1 2 3 4 5 6 7

Totally Disagree Totally Agree

2) Using ChatGPT **improves** my overall academic performance. *

1 2 3 4 5 6 7

Totally Disagree Totally Agree

3) Using ChatGPT **meets** my academic learning expectations. *

1 2 3 4 5 6 7

Totally Disagree Totally Agree

Appendix C

Turnitin Report

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: 01/10/2013	Page No.: 1 of 1



FACULTY OF SCIENCE

Full Name(s) of Candidate(s)	YAP ZHI HUI
ID Number(s)	19ADB03810
Programme / Course	Bachelor of Science (HONS) Statistical Computing and Operations Research
Title of Final Year Project	Exploring Contributing Factors and Their Inter-relationship Towards the Effective Usage of ChatGPT in Academic Learning among UTAR Kampus Undergraduates

Similarity	Supervisor's Comments (Compulsory if parameters of originality exceeds the limits approved by UTAR)
Overall similarity index: <u> 16 </u> % Similarity by source Internet Sources: <u> 10 </u> % Publications: <u> 11 </u> % Student Papers: <u> 6 </u> %	
Number of individual sources listed of more than 3% similarity: <u> 0 </u>	
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 <i>Note: Parameters (i) – (ii) shall exclude quotes, bibliography and text matches which are less than 8 words.</i>	

Note 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
 Name: YEOH HONG BENG
 Date: 15/4/2024

 Signature of Co-Supervisor
 Name: * _____
 Date: * _____

Appendix D

Originally Report

Exploring contributing factors and their inter-relationships toward the effective usage of ChatGPT in academic learning among UTAR Kampar undergraduates.

ORIGINALITY REPORT

16% SIMILARITY INDEX	10% INTERNET SOURCES	11% PUBLICATIONS	6% STUDENT PAPERS
--------------------------------	--------------------------------	----------------------------	-----------------------------

PRIMARY SOURCES

1	Submitted to Universiti Tunku Abdul Rahman Student Paper	2%
2	Yeoh Hong Beng, Wei Chooi Yi, Surindar Kaur. "Examining tertiary learners' preparedness to face their future employment in fourth industrial revolution era", AIP Publishing, 2023 Publication	1%
3	ojs.amhinternational.com Internet Source	1%
4	eprints.utar.edu.my Internet Source	1%
5	worldwidescience.org Internet Source	1%
6	Islam, A.Y.M. Atiquil. "Development and Validation of the Technology Adoption and Gratification (TAG) Model in Assessing	1%

Appendix E

PAPER ACCEPTANCE LETTER FOR THE 19th IMT-GT INTERNATIONAL CONFERENCE ON MATHEMATICS, STATISTICS AND THEIR APPLICATIONS (ICMSA 2024)



UNIVERSITI TUNKU ABDUL RAHMAN (DU01214E)
Wholly owned by UTAR Education Foundation Co. No. 5782274F

Dear Prof./ Dr./ Mr/ Ms Yeoh Hong Beng

**PAPER ACCEPTANCE LETTER FOR THE 19TH IMT-GT INTERNATIONAL
CONFERENCE ON MATHEMATICS, STATISTICS, AND THEIR APPLICATIONS (ICMSA
2024)**

I am glad to let you know that your paper titled:

Paper Title : Examining technological performance-related variables for effective usage of ChatGPT in academic learning of tertiary learners

has been accepted for **oral presentation** for The 19th IMT-GT International Conference on Mathematics, Statistics, and Their Applications (ICMSA 2024) that to be held on 27 and 28 May 2024.

Please refer to the following paper ID for future correspondence.

Paper ID : X5K3W

Please complete the registration procedure as soon as possible to ensure that your publication is included in the proceedings. Your camera-ready paper should be submitted via the provided link (<https://icmsa2024.utar.edu.my/submission>) by 1 May 2024.

Note: The full conference schedule will be available on the conference website. Please check the website regularly.

Thank you very much for your interest in The 19th IMT-GT International Conference on Mathematics, Statistics, and Their Applications (ICMSA 2024) and looking forward to see you in the conference.

Yours sincerely,

Assoc Prof. Dr Goh Yong Kheng
Chairperson,
ICMSA 2024
Universiti Tunku Abdul Rahman
Jalan Sungai Long, Bandar Sungai Long,
Cheras, 43000 Kajang,
Selangor, Malaysia.
Email: icmsa@utar.edu.my

Appendix F

Camera Ready Conference Paper with Title of “Examining technological performance-related variables for effective usage of ChatGPT in academic learning of tertiary learners”

*Yeoh Hong Beng*¹¹, and *Yap Zhi Hui*²

¹Centre for Learning and Teaching, Universiti Tunku Abdul Rahman, Kampar Campus, Jalan Universiti, Bandar Barat, 31900 Kampar, Perak, Malaysia

²Department of Physical and Mathematical Sciences, Faculty of Science, Universiti Tunku Abdul Rahman, Kampar Campus, Jalan Universiti, Bandar Barat, 31900 Kampar, Perak, Malaysia

Abstract. Recently, ChatGPT is widely leveraged as information searching and drilling natural language processing tool to facilitate academic learning. However, a comprehensive framework is indeed lacking for its effective deployment in educational institutions. Thus, this research aims to analyse technological performance-related variables while using ChatGPT, namely technological self-efficacy, acceptance level and job expectancy, and their inter-relationships to support effective usage of ChatGPT among tertiary learners for their academic learning. Quantitative research via questionnaire survey was conducted. All question items in the questionnaire were adapted from past related studies. The respondents were recruited using multi-staged cluster sampling technique at main campus of a comprehensive university in Malaysia. Data collected from 230 tertiary learners were analysed using Partial Least Square-Structural Equation Modeling (PLS-SEM). The research finding shows that tertiary learners’ job expectancy on the outcomes of using ChatCPT and their self-efficacy to use ChatGPT significantly affect its effective usage in their academic learning. Besides, both tertiary learners’ self-efficacy and job expectancy when using ChatGPT are significantly affected by their perceived usefulness and importance of ChatGPT. In addition, tertiary learners’ self-efficacy in ChatGPT is also significantly influenced by their behavioural intention to use it. Furthermore, the relationship between tertiary learners’ perceived ease of use and their behavioural intention to use ChatGPT is partially mediated by their perceived usefulness and importance of ChatGPT. Besides, the tertiary learners’ behavioural intention to use ChatGPT partially mediates the relationship between their perceived usefulness and importance and self-efficacy to use it in their academic learning. These research results provide an insight to related stakeholders, including tertiary learners and higher education decision makers, on their initiatives to facilitate and manage the usage of ChatGPT as a learning tool in tertiary educational institutions.

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Introduction

OpenAI released Chat Generative Pre-Trained Transformer (ChatGPT) on 30th November 2022. It uses human language processing tool which is designed to understand the conversational context and generate responses that are relevant and captivating to the prompts provided by its users. ChatGPT adopts advanced version of the GPT-3 family of large language models (LLM) that are specifically designed for conversational Artificial Intelligence [1]. Nowadays, ChatGPT becomes increasingly popular as a learning tool in education. It is capable of answering academic prompts and queries raised by learners by integrating knowledge bases from various sources and subject areas, classifying and summarizing a given text and even debugging programming codes [1]. On top of it, ChatGPT engages in personalized, dynamic, interactive and contextually relevant conversations with its end users [2].

As ChatGPT continues to evolve, learners encounter various challenges to use it. ChatGPT has the potential of providing fake and wrong information [3]. Besides, it might lead to academic cheating and plagiarism [1]. Therefore, in order to leverage ChatGPT effectively, these associated risks need to be mitigated. Currently, there is a lack of comprehensive framework for effective deployment of ChatGPT in educational institutions. Thus, this research aims to analyse technological performance-related variables while using ChatGPT, namely technological self-efficacy, acceptance level and job expectancy, and their inter-relationships to support effective usage of ChatGPT among tertiary learners in their academic learning.

Literature review

According to Venkatesh et al. [4] and Yeoh et al. [5], the effective usage of technology was indeed influenced by various factors, including end users' technological job expectancy, self-efficacy, and acceptance level. Technological job expectancy refers to an individual expectation on the usage of a related technology that leads to improvement in his/her job performance [4]. The expectancy theory developed by Vroom [6] states that individuals make choices and engage in activities based on the expectation that certain actions taken lead to positive outcomes [7]. In this research, tertiary learners' job expectancy on ChatGPT refers to their perception on the outcomes of using ChatGPT for better academic learning as well as improved learning time and effort efficiency. On the other hand, self-efficacy is one's belief in his/her ability to perform a specific task assigned and accomplish its goals [8]. The degree of an individual's self-efficacy plays a crucial role in shaping his/her perseverance in learning new skills that impact his/her job performance [9]. In this research, tertiary learners' self-efficacy is associated with their believed ability to use the ChatGPT. It involves the learners' confidence in their capability to interact with the ChatGPT and generate responses that meet their academic learning goals or needs.

Besides, technological level of acceptance is interpreted as willingness of a person to recognize and embrace a new technology into his/her life or work [4]. High level of acceptance of a technology among end users leads to the smooth integration of the adopted technology into organizations [10]. In this research, the acceptance level of ChatGPT is manifested by Technology Acceptance Model (TAM). It is a widely utilized as a theoretical framework for evaluating users' adoption and acceptance of new Information Technology. TAM suggests that the perceived usefulness and ease of use of a technology are key factors that influence users' attitude and behavioural intention to use the technology [4]. Perceived usefulness focuses on the users' belief about the extent to which an adopted technology can enhance their job performance. If users perceive a technology as a useful tool in improving their job efficiency and effectiveness, they are more likely to accept and adopt it [5]. In this research, tertiary learners' perceived usefulness and importance refers to the degree to which they believe that using ChatGPT can enhance their learning and academic outcomes. Perceived ease of use is the user's perception of how easy it is to use the technology. If users find a technology is easy to use, they are more inclined to accept and use it in daily life [11]. In this research, tertiary learners' perceived ease of use of ChatGPT is related to their belief about how user-friendly to interact with and utilize ChatGPT in their academic learning. One's behavioural intention to use a technology describes his/her

expressed willingness to accept and adopt a particular technology [12]. In the context of TAM, behavioural intention to use a technology is a key factor that predicts whether the users are likely to adopt or use the technology [4]. In this research, tertiary learners' behavioural intention to use ChatGPT is reflected by their willingness to engage with ChatGPT and utilize it for their academic learning purposes.

3 Hypotheses development

End users' positive job expectancy on the adaptation of a new technology significantly influences their present and future actions to leverage the technology [13]. In other words, end users who expect an adopted technology to bring about better work performance and efficiency tend to use the technology. More specifically, the users having positive job expectancy of ChatGPT are more likely to adopt it to complete their assigned tasks [14]. Therefore, the following hypothesis is proposed.

H_{a1}: Tertiary learners' job expectancy on ChatGPT has significant effect on its effective usage in their academic learning.

Individuals who possess high self-efficacy in leveraging a technology have greater success in the usage of the technology [15]. In addition, an individual with a strong belief in his/her ability to perform technological job assignments has significantly enhanced his/her performance to complete them both qualitatively and quantitatively [16]. Thus, the following hypothesis is initiated.

H_{a2}: Tertiary learners' self-efficacy to use ChatGPT has significant effect on its effective usage in their academic learning.

Venkatesh et al. stated that users' behavioural intention to use a technology positively influences their actual behavior to use the technology [4]. For users having stronger intention to use the technology, they are more likely to accept and use it [17]. Besides, Shahsavar and Choudhury also found that users' actual usage of ChatGPT is influenced by their behavioural intention to use it [14]. Hence, the following hypothesis is tested.

H_{a3}: Tertiary learners' behavioural intention to use ChatGPT has significant effect on its effective usage in their academic learning.

A person's intention to engage with a behavior is based on his/her expectation and evaluation on the outcomes of such behavior [17]. According to research carried out by Jian-Liang Chen, students' behavioural intention to use a technology is primarily influenced by their job expectancy on the technology [17]. Job expectancy is closely tied to end users' perception of the technology's functionalities and its effectiveness in helping them to perform their assignments. Nikou and Economides also stated that job expectancy is a significant determinant of behavioural intention to use an adopted technology [18]. As a result, the following hypothesis is set up.

H_{a4}: Tertiary learners' job expectancy on ChatGPT has significant effect on their behavioural intention to use it in their academic learning.

According to the research carried out by Williams, expected outcomes of a person's behavior influence his/her level of self-efficacy [19]. More specifically, end users' job expectancy on a technology has significant influence on their self-efficacy to use the technology [8]. So, the following hypothesis is established.

H_{a5}: Tertiary learners' job expectancy on ChatGPT has significant effect on their self-efficacy to use it in their academic learning.

The Technological Acceptance Model 2 (TAM2), which is the extension of TAM, has identified users' perceived ease of use influences their perceived usefulness and behavioural intention to use Information Technologies [20]. It is consistent with the research findings by Baharin et al. [21]. A user-friendly technology improves overall users' experience on its usefulness that leads to its better adaptation and usage [22]. Hence, the following hypotheses are initiated.

H_{a6}: Tertiary learners' perceived ease of use of ChatGPT has significant effect on their behavioural intention to use it in their academic learning.

H_{a7}: Tertiary learners' perceived ease of use of ChatGPT has significant effect on their perceived usefulness and importance of ChatGPT.

The Technology Acceptance Model 3 (TAM3), which is the extension beyond TAM2, identifies users' perceived usefulness has a significant influence on their behavioural intention to adopt and use a technology [23]. Besides, Chin et al. found that users' perceived usefulness and importance in Artificial Intelligence (AI) positively influences their behavioural intention to use its services [24]. The relationships among perceived technological usefulness and importance, job expectancy, behavioural intention to use and self-efficacy are further justified by the research findings by Yeoh et al. [5]. Users who find a technology useful and important tend to expect more positive outcomes when using the technology. As a result of it, they are more motivated to use the technology. Consequently, users' self-efficacy in leveraging the technology is expected to be further reinforced. Thus, the following hypotheses are constructed.

H_{a8}: Tertiary learners' perceived usefulness and importance of ChatGPT has significant effect on their behavioural intention to use it in their academic learning.

H_{a9}: Tertiary learners' perceived usefulness and importance of ChatGPT has significant effect on their job expectancy of ChatGPT.

H_{a10}: Tertiary learners' perceived usefulness and importance of ChatGPT has significant effect on their self-efficacy to use it.

H_{a11}: Tertiary learners' behavioural intention to use ChatGPT has significant influence on their self efficacy to use it.

According to studies carried out by Venkatesh and Davis [20] and Venkatesh and Bala [23], users' perceived ease of use of a technology has an indirect impact on their behavioural intention to use the technology. Besides, there are significant positive relationships among perceived usefulness and importance, perceived ease of use and behavioural intention to use a technology [25-26]. Users who find a technology easy to use are expected to perceive it as useful and important. These positive perceptions subsequently influence users' behavioural intention to use the technology. In line with this presumption, the following hypothesis is put forward.

H_{a12}: The relationship between tertiary learners' perceived ease of use and behavioral intention to use ChatGPT is mediated by their perceived usefulness and importance of ChatGPT.

Users' perceived usefulness and importance on a technology has positively related to their self-efficacy to use the technology [5]. As users' perceived usefulness and importance on a technology increases, their self-efficacy to use the technology also improves [13]. Besides, there is a significant positive relationship between users' perceived usefulness and importance and their behavioural intention to use a technology [20]. In addition, self-efficacy to use the technology also influenced by behavioural intention to use the technology [5]. Therefore, the proposed hypothesis is stated as follows.

H_{a13}: The relationship between tertiary learners' perceived usefulness and importance and self-efficacy of ChatGPT is mediated by their behavioural intention to use it.

The hypotheses developed are summarized to form the research theoretical framework as shown in Figure 1.

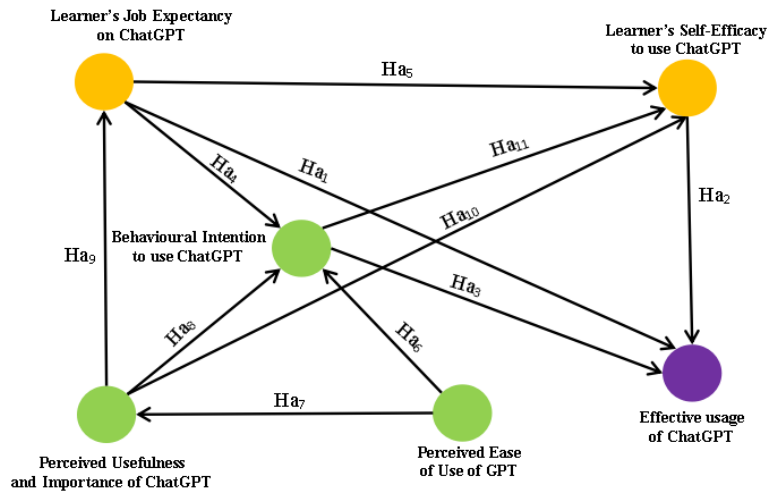


Fig. 1. Research Theoretical Framework.

4 Methodology

The main aim of the research is to analyse inter-relationship among technological performance-related variables, namely technological job expectancy, self-efficacy and acceptance level, and their impacts on the effective usage of ChatGPT in academic learning among tertiary learners. The target population for this study comprises all undergraduates from all the five faculties in the main campus of a private university in Malaysia. The research design applied for this study is quantitative research via questionnaire survey. The questionnaire consists of tertiary learners' demographic information and inquiry question items that relate to respondent's perception on technological performance-related variables and effective usage of ChatGPT in their academic learning. The question items in the questionnaire, except for the section on demographic information, use a seven-point Likert scale. In the section which focuses on technological performance-related variables, a frequency-based Likert scale consisting of options of never (1), very rarely (2), rarely (3), sometimes (4), frequently (5), very frequently (6), and always (7) is used. It's to discern the frequency with which learners express how consistently the use of ChatGPT meets their job expectations in academic learning, their acceptance level of ChatGPT, and how confident they have in their ability to do the assigned tasks with ChatGPT. On the other hand, the Likert scale comprising options of totally disagree (1), strongly disagree (2), disagree (3), neutral (4), agree (5), strongly agree (6) and totally agree (7) is applied to analyze the perceived effectiveness of using ChatGPT by tertiary learners in their academic learning. The question items in the designed questionnaire are adapted and compiled from the efforts of Yeoh et al. [5] and Han et al. [27].

The sampling technique deployed in the research is multi-staged cluster sampling as the target population of the university's tertiary learners is naturally categorized into distinct clusters based on faculty attached,

degree program registered, and courses attended in each trimester. At first stage, a degree program is randomly selected from all undergraduate programs offered by each of five faculties at the university. Then, an offered course is randomly chosen from each selected degree program from the five faculties. After that, from a list of scheduled lectures for each of the selected courses, a lecture time slot is randomly chosen. Finally, the students who attend the chosen lecture time will participate in the questionnaire survey. There was a total of 230 respondents involved in this research fieldwork.

In this research, Partial Least Squares-Structural Equation Modeling (PLS-SEM) is used for data analysis as it is well-suited for studying complex model with various latent constructs. Its algorithm involves the usage of partial least squares method to estimate the parameters of a research structural model in order to predict the variation of endogenous constructs of the model by applying ordinary least squares regression models of the exogenous constructs in it. Besides, it is robust to analyze small size of data collected that do not strictly follow the assumption of a multivariate normal distribution. In this research, PLS-SEM is more preferred compared to Covariance Based Structural Equation Modeling (CB-SEM) because the research framework is causal and predictive in nature [28].

5 Results

Table 1. Respondents' demographic information.

Respondent's Profile	Categories	Frequency	Sample (%)
Gender	Male	129	56.10
	Female	101	43.90
Faculty	FSC	47	20.40
	FEGT	6	2.60
	FBF	89	38.70
	FICT	84	36.50
	FAS	4	1.70

In the research fieldwork conducted, a total of 230 respondents were involved. As summarised in Table 1, 129 (56.10%) were male respondents, while the remaining were females. 20.40%, 2.60%, 38.7%, 36.50%, and 1.70% of research sample tertiary learners were from Faculty of Science (FSC), Faculty of Engineering and Green Technology (FEGT), Faculty of Business and Finance (FBF), Faculty of Information and Communication Technology (FICT) and Faculty Arts and Social Science (FAS) respectively.

Table 2. Indicators' loadings and constructs' internal reliability.

Construct	Loading	Cronbach's Alpha	ρ_A	CRI	AVE
<u>Learner's Job Expectancy on ChatGPT (JE)</u> JE1. Using ChatGPT, I expect to perform better in my academic assessments (such as assignments and projects). JE2. Using ChatGPT, I expect to learn more about subject matter in my field of study. JE3. Using ChatGPT, I expect to improve time	0.873*	0.875	0.880	0.923	0.800

and effort efficiency in my academic learning.					
<u>Perceived Usefulness and Importance (PUI) of ChatGPT</u> PUI1. I believe ChatGPT is useful to support my academic learning. 0.941* PUI2. I believe ChatGPT is valuable to support my academic learning. 0.953* PUI3. I believe ChatGPT is important to support my academic learning. 0.931*		0.936	0.937	0.959	0.887
<u>Behavioural Intention to use (BIU) ChatGPT</u> BIU1. I intend to use ChatGPT in my academic learning. 0.926* BIU2. I predict I would use ChatGPT in my academic learning. 0.929* BIU3. I plan to use ChatGPT in my academic learning. 0.933*		0.921	0.921	0.950	0.864
<u>Perceived Ease of Use (PEU) of ChatGPT</u> PEU1. As an end user, I find it is easy to use ChatGPT to do what I what it to do. 0.901* PEU2. As the end user, I believe interacting with ChatGPT does not require a lot of my mental effort. 0.903* PEU3. As an end user, I perceive that using ChatGPT does not need to refer the user manual/help guide provided. 0.831*		0.853	0.876	0.910	0.772
<u>Learner's Self-Efficacy (SEff) to use ChatGPT</u>		0.918	0.919	0.942	0.803

SEff1. I feel confident in my ability to use ChatGPT for my academic learning.	0.872*				
SEff2. I feel I am on the top of things (or in full control) when I use ChatGPT for my academic learning.	0.909*				
SEff3. I feel that things are going on the way I want to when I use ChatGPT for my academic learning.	0.909*				
SEff4. I am certain that I can use ChatGPT effectively for my academic learning.	0.893*				
<u>Effective usage (EU) of ChatGPT</u>		0.928	0.928	0.954	0.874
EU1. Using ChatGPT fulfills my learning needs and requirements .	0.926*				
EU2. Using ChatGPT improves my overall academic performance .	0.947*				
EU3. Using ChatGPT meets my academic learning expectations .	0.931*				
Notes: * For $n = 5000$, p value < 0.05 ; ρ_A = Dijkstra-Henseler's rho; CRI= Composite Reliability Index; AVE= Average Variance Extracted.					

Referring to Table 2, the indicators for all constructs in the research theoretical model are reliable measures of their respective latent constructs as their loading values are above 0.708. Besides, high level of internal consistency and reliability of the indicators in their respective constructs are justified since the composite reliability, Cronbach's alpha, and Dijkstra-Henseler's rho (ρ_A) values for all the constructs are above 0.70. As the Average Variance Extracted (AVE) values for all the constructs are above 0.50, it implies acceptable convergent validity of the latent constructs by their respective indicators [28].

Table 3. Fornell-Larcker criterion.

Latent Construct	BIU	EU	JE	PEU	PUI	SE
Behavioural Intention to use (BIU)	0.929					
Effective usage of ChatGPT(EU)	0.780	0.935				
Learner's Job Expectancy for ChatGPT(JE)	0.717	0.711	0.894			
Perceived Ease of Use (PEU)	0.782	0.712	0.637	0.879		
Perceived Usefulness and Importance (PUI)	0.845	0.784	0.773	0.767	0.942	
Learner's Self-Efficacy to use ChatGPT(SEff)	0.773	0.847	0.583	0.761	0.745	0.896

The Fornell-Larcker criterion compares the square of the correlation coefficients among all constructs with the average variance extracted (AVE) of each construct in the research theoretical framework. As shown in Table 3, as AVE values of each construct is higher than all the squared correlation coefficients between the construct and other constructs, discriminant validity among all constructs in the research theoretical framework is justified. [28].

Table 4. Variance Inflation Factor (VIF) values of related constructs.

Latent Construct	BIU	EU	JE	PUI	SE
Behavioural Intention to use (BIU)	-	-	-	-	3.622
Learner's Job Expectancy for ChatGPT(JE)	2.513	1.514	-	-	2.573
Perceived Ease of Use (PEU)	2.457	-	-	1.000	-
Perceived Usefulness and Importance (PUI)	3.628	-	1.000	-	4.377
Learner's Self-Efficacy to use ChatGPT(SEff)	-	1.514	-	-	-

The collinearity among the exogenous constructs in the research theoretical framework is evaluated by the variance-inflation factor (VIF). As indicating in Table 4, all VIF values for the constructs are between 1 and 5. This implies that there is no occurrence of major collinearity problems among exogenous constructs in the research model [28].

Table 5. p values, t-statistics, 95 percentile bootstrap confidence intervals (CIs).

Hypothesis	P value	t statistic	95 percentile Bootstrap CI	Supported
H_{a1}: JE → EU	0.000	5.313	[0.182,0.386]	Yes
H_{a2}: SEff → EU	0.000	9.046	[0.453,0.705]	Yes
H_{a3}: BIU → EU	0.062	1.868	[-0.004,,263]	No
H_{a4}: JE → BIU	0.051	1.953	[0.002,0.253]	No
H_{a5}: JE → SEff	0.462	0.736	[-0.220,0.117]	No
H_{a6}: PEU → BIU	0.000	4.421	[0.181,0.461]	Yes
H_{a7}: PEU → PUI	0.000	21.001	[0.689,0.834]	Yes
H_{a8}: PUI → BIU	0.000	6.816	[0.358,0.649]	Yes
H_{a9}: PUI → JE	0.000	21.607	[0.699,0.839]	Yes
H_{a10}: PUI → SEff	0.000	3.669	[0.156,0.534]	Yes
H_{a11}: BIU → SEff	0.000	6.067	[0.343,0.680]	Yes

From the research results summarised in Table 5, there is sufficient evidence to conclude that tertiary learners’ job expectancy and self-efficacy have a significant influence on the effective usage of ChatGPT in their academic learning. Besides, tertiary learners’ perceived ease of use of ChatGPT significantly affect their behavioural intention to use and perceived usefulness and importance of ChatGPT. In addition, tertiary learners’ behavioural intention, self-efficacy to use ChatGPT and their job expectancy for ChatGPT are significantly influenced by their perceived usefulness and importance of ChatGPT. Furthermore, tertiary learner’s behavioural intention to use ChatGPT has a significant influence on their self-efficacy to use ChatGPT in their academic learning.

Table 6. Mediating Effects.

Mediating Effect		p-value	$VAF = \frac{Indirect\ effect}{total\ effect}$	Supported
H_{a12}: The relationship between PEU and BIU is mediated by PUI.				Yes
Direct Effect	PEU → BIU	0.000	=0.388/0.777	
	PEU → PUI	0.000		
	PUI → BIU	0.000	=0.499	
Indirect Effect	PEU → PUI → BIU	0.000		
H_{a13}: The relationship between PUI and SE is mediated by BIU.				Yes
Direct Effect	PUI → SE	0.000	=0.261/0.617	
	PUI → BIU	0.000		
	BIU → SE	0.000	=0.423	
Indirect Effect	PUI → BIU → SE	0.000		

As indicated in Table 6, tertiary learners’ perceived usefulness and importance play a significant mediating role in the relationship between their perceived ease of use and behavioural intention to use ChatGPT in their academic learning. Since the value accounted for (VAF) the mediation effect is 0.499, learners’ perceived usefulness and importance is a partial mediator in the relationship stated above. Besides, the

tertiary learners' behavioural intention to use ChatGPT partially mediates the relationship between their perceived usefulness and self-efficacy of ChatGPT [29].

Table 7. R-squared and Q-squared values.

Construct	R-square	R-square adjusted	Q²
BIU	0.764	0.761	0.608
EU	0.794	0.791	0.545
JE	0.597	0.595	0.398
PUI	0.588	0.586	0.584
SE	0.628	0.623	0.559

The coefficient of determination (R-squared value) measures the proportion of the variance in an endogenous latent construct that is explained by its exogenous constructs in the research model [28]. Table 7 shows that the research theoretical framework explains 79.4% and 76.4% of the variance in tertiary learners' effective usage and behavioural intention to use ChatGPT respectively. Besides, learners' job expectancy for ChatGPT, perceived usefulness and importance, and self-efficacy have moderate explanatory power by their respective exogenous constructs in the research model as they have R-squared values of 0.597, 0.588, and 0.628 respectively.

Q-squared value computed provides information about the research model's ability to predict its endogenous latent constructs in the research model out of samples collected in the research fieldwork [28]. Referring to Table 7, as Q-squared values for all the endogenous constructs in the research model are above 0, the research path model is predictive relevance.

6 Discussion

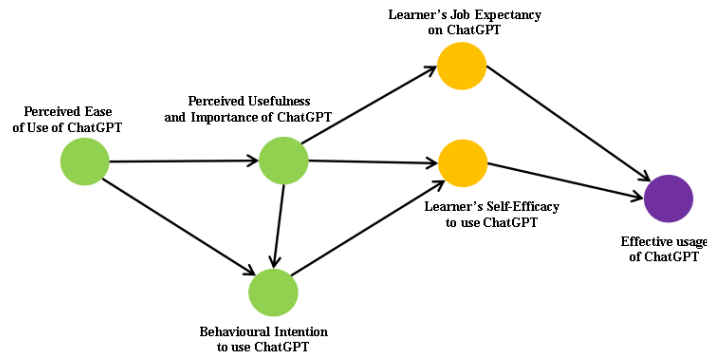


Fig. 2. Summary of the research findings.

From the significant research results summarized in Figure 2, effective usage of ChatGPT among tertiary learners in their academic learning is significantly influenced by their job expectancy and self-efficacy to use it. These findings align with the existing literature that effective usage of a technology is influenced by end users' job expectancy [13-14] and self-efficacy [15-16]. Tertiary learners' expectations on performing better academically, learning more about their subject matter and improving learning efficiency while using ChatGPT facilitate their effective usage of ChatGPT in their academic learning. In addition, tertiary learners' confidence and believed capabilities to leverage ChatGPT enable them to use ChatGPT effectively in their academic learning.

Besides, tertiary learners' perceived usefulness and importance of ChatGPT have a significant influence on their perceived job expectancy, self-efficacy and behavioural intention to use ChatGPT. These findings are consistent with the research carried out in adaptation of 4th Industry Revolution driven technologies [5]. Tertiary learners' perceived usefulness and importance of ChatGPT is expected to motivate them to better understand the utilities and functionalities of ChatGPT. As a result, tertiary learners are more confident to manage the usage of ChatGPT in their academic learning [30]. Furthermore, tertiary learners who perceive ChatGPT as valuable learning tool tend to recognize positive outcomes of using it and enhance their intention to use it. On top of it, tertiary learners' behavioural intention to use ChatGPT significantly affect their self-efficacy to use it. Tertiary learners' behavioural intention to use ChatGPT reflects their levels of acceptance in ChatGPT. Once there is high acceptance level to ChatGPT, tertiary learners are expected to have more confidence to leverage ChatGPT effectively in their academic learning.

Furthermore, tertiary learners' perceived ease of use of ChatGPT directly affects their behavioural intention to use it and perceived usefulness and importance of it. These research results are consistent with past similar studies [20-21]. When tertiary learners perceive ChatGPT is user-friendly, they not only comfortably recognize useful and important utilities of ChatGPT, but also enhance the behavioural intention to use the ChatGPT in academic learning. On the other hand, relationship between tertiary learners' perceived ease of use and behavioural intention to use ChatGPT is partially mediated by their perceived usefulness and importance of a technology. This research result is consistent with the finding by Venkatesh and Davis [20]. Tertiary learners' perceived ease of use of ChatGPT directly influences their behavioural intention to use ChatGPT. At the same time, tertiary learners have higher intention to use ChatGPT if they also recognize the value and importance of ChatGPT in their academic learning. Besides, the relationship between tertiary learners' perceived usefulness and importance of ChatGPT and their self-

efficacy to use ChatGPT is partially mediated by their behavioural intention to use it. This research finding is supported by past studies on new technological adaption in organizations [5,13,20]. In order to enhance tertiary learners' self-efficacy to use ChatGPT, firstly they need to perceive ChatGPT as useful and important learning tool. Then, their self-efficacy to use ChatGPT can be further improved by their behavioural intention to use it over times. In other words, once tertiary learners view ChatGPT as valuable learning tool, they have higher intention to use it. As a result, they are more confident to manage ChatGPT for their academic learning.

7 Conclusion

This research aims to analyse inter-relationship among technological performance-related variables, namely technological job expectancy, self-efficacy and acceptance level, and their impacts on the effective usage of ChatGPT in academic learning among tertiary learners. The research results conclude that tertiary learners' job expectancy on the outcomes of using ChatCPT and their self-efficacy to use ChatGPT significantly affect its effective usage in their academic learning. Besides, both tertiary learners' self-efficacy and job expectancy when using ChatGPT are significantly affected by their perceived usefulness and importance of ChatGPT. In addition, tertiary learners' self-efficacy in ChatGPT is also significantly influenced by their behavioural intention to use it. Furthermore, the relationship between tertiary learners' perceived ease of use and their behavioural intention to use ChatGPT is partially mediated by their perceived usefulness and importance of ChatGPT. Besides, the tertiary learners' behavioural intention to use ChatGPT partially mediates the relationship between their perceived usefulness and importance and self-efficacy to use it in their academic learning. These research findings enable tertiary learners to gain further insight on how to use ChatGPT effectively for their academic learning purposes. Besides, the research findings can be used as a term of reference for the policy makers such as the university management and the Ministry of Higher Education to facilitate and manage the usage of ChatGPT as a learning tool in tertiary educational institutions.

As ChatGPT has the potential to provide inaccurate information and lead to academic plagiarism, future research is recommended to explore the effect of tertiary learners' self performance-related variables, including their learning skills and attitudes such as critical thinking skills, life-long learning and academic integrity to facilitate effective usage of ChatGPT in academic learning among tertiary learners.

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