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

Hong Beng Yeoh[1*], and *Zhi Hui* Yap[2]

[1]Centre for Learning and Teaching, Universiti Tunku Abdul Rahman, Kampar Campus, Jalan Universiti, Bandar Barat, 31900 Kampar, Perak, Malaysia
[2]Department 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. On top of it, 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.

*Corresponding author: yeohhb@utar.edu.my

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 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.

2 Literature review

According to Venkatesh et al. [4] and Yeoh et al. [5], the effective usage of technology is 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 to evaluate 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' behavourial 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 behavorial 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.

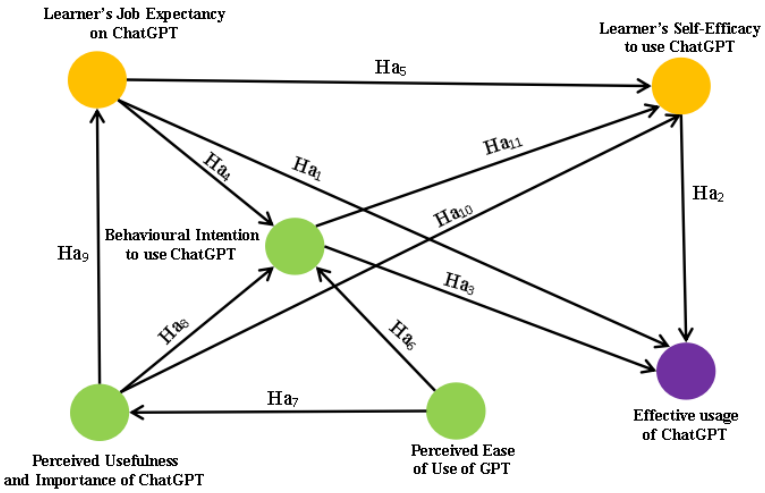

Fig. 1. Research Theoretical Framework.

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 the 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 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
Learner's Job Expectancy on ChatGPT (JE)		0.875	0.880	0.923	0.800
JE1. Using ChatGPT, I **expect** to **perform better in my academic assessments** (such as assignments and projects).	0.873*				
JE2. Using ChatGPT, I **expect** to **learn more about subject matter** in my field of study.	0.912*				
JE3. Using ChatGPT, I **expect** to **improve time and effort efficiency** in my academic learning.	0.898*				
Perceived Usefulness and Importance (PUI) of ChatGPT		0.936	0.937	0.959	0.887
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*				

Behavioural Intention to use (BIU) ChatGPT		0.921	0.921	0.950	0.864
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*				
Perceived Ease of Use (PEU) of ChatGPT		0.853	0.876	0.910	0.772
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*				
Learner's Self-Efficacy (SEff) to use ChatGPT		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*				

Effective usage (EU) of ChatGPT		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 (ρA) 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 and self-efficacy to use ChatGPT as well as 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	=0.499	
	PUI→ BIU	0.000		
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	=0.423	
	BIU→ SE	0.000		
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.

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

Construct	R-square	R-square adjusted	Q^2
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

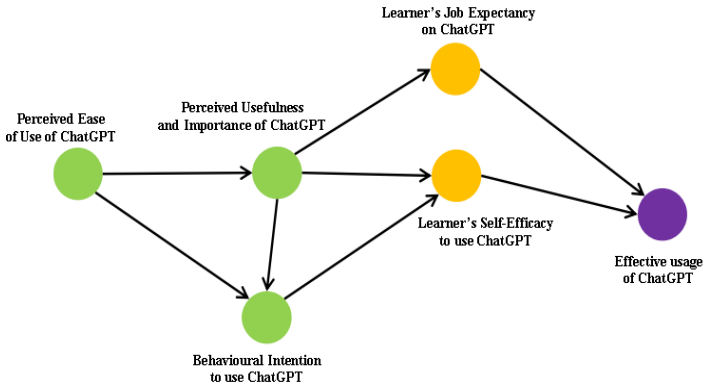

Fig. 2. Summary of the research findings.

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 [29]. 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.

The study is supported by Universiti Tunku Abdul Rahman (UTAR), Malaysia.

References

1. M. Abdullah, A. Madain, and Y. Jararweh, 2022 Ninth International Conference on Social Networks Analysis, Management and Security (SNAMS) 1 (2022)
2. J. Deng and Y. Lin, Frontiers in Comp. and Intell Syst **2**, 81 (2023)
3. S. Eken, SSRN Electronic J., **1** (2023)
4. V. Venkatesh, M.G. Morris, G.B. Davis, and F.D. Davis, MIS Quarterly **27**, 425 (2003)
5. H.B. Yeoh, Y.C. Wei, S. Kaur, In AIP Conference Proceedings, **2608**(1). AIP Publishing (2023)
6. V.H. Vroom, Work and motivation. Wiley, 432 (1964)

7. V.H. Vroom, L. Porter, E. Lawler, Expectancy theories. In Organizational Behavior 1, 94 (2015)
8. M.S. Latip, I. Noh, M. Tamrin, and S.N. Latip, Int. J. of Acad. Res. in Bus. and Soc. Sci. **10**, 658 (2020)
9. G. Mustafa, R. Glavee-Geo, K. Gronhaug, and H. Saber Almazrouei, Sustainability **11**, 860 (2019)
10. J.L. Hero, Puissant, **1**, 59 (2020)
11. F.D. Davis, MIS Quarterly **13**, 319 (1989)
12. E. Aditia, I.N. Tela, N. Saleh, D. Ilona, and Zaitul, MATEC Web of Conferences **248**, 05004 (2018)
13. W.H. Sang, KSII Trans. on Internet and Inf. Syst. **12**, (2018)
14. Y. Shahsavar and A. Choudhury, JMIR Human Factors **10**, (2023)
15. V. Celik and E. Yesilyurt, Comp. & Edu. **60**, 148 (2013)
16. R. Renn, J. Manage. **27**, 563 (2001)
17. J.L. Chen, Comp. Edu. **57**, 1501 (2011)
18. S.A. Nikou and A.A. Economides, Comp. & Edu. **109**, 56 (2017)
19. D.M. Williams, Pers. Soc. Psychol. Rev. **14**, 417 (2010)
20. V. Venkatesh and F.D. Davis, Manag. Sci. **46**, 186 (2000)
21. A.T. Baharin, H. Lateh, S.S. Nathan, and H. mohd Nawawi, Procedia – Soc. Behav. Sci. **171**, 897 (2015)
22. M. W. Raksadigiri, S. Wahyuni, Int. J. of Adv. Res., **8**, 439 (2020)
23. V. Venkatesh and H. Bala, Decis. Sci. **39**, 273 (2008)
24. J.H. Chin, C. Do, and M. Kim, Int. J. Environ. Res. and Public Health **19**, 14453 (2022)
25. S. O. U. D. Almahamid, A. C. Mcadams, Al Kalaldeh, T. A. H. E. R., MO'TAZ, A. S. E. J. of Theor. Appl. Inf. Technol., **11**, 30 (2010)
26. G. Widiar, A. Yuniarinto, and I. Yulianti, Interdiscip. Soc. Stud. **2**, 1829 (2023)
27. J. Han, H. Yoo, Y. Kim, J. Myung, M. Kim, H. Lim, J. Kim, T.Y. Lee, H. Hong, S.-Y. Ahn, and A. Oh, Proceedings of the Tenth ACM Conference on Learning @ Scale, 1-8 (2023)
28. J.F. Hair, J.J. Risher, M. Sarstedt, and C.M. Ringle, European Bus. Rev. **31**, 2 (2019)
29. R. N. Rahmawati, Am. J. Humanit. Soc. Sci. Res., **3**(5), 41 (2019)