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Mediating Role of Cognitive Skills in Online Shopping: An empirical study in Malaysia using UTAUT2

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Abstract
The Fourth Industrial Revolution has accelerated digital business transformation, particularly online shopping in Malaysia. This study examines factors influencing customer experience using data from a 55-responder pilot test. Grounded in the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) framework, it explores the roles of performance expectancy, effort expectancy, and cognitive skills as mediating variables. Partial Least Squares Structural Equation Modelling (PLS-SEM) analysis reveals significant influences of performance and effort expectancy, with cognitive skills serving as a mediator that enhances user engagement and satisfaction. These findings provide valuable early insights for optimizing e-commerce strategies, improving interface usability, and advancing digital literacy in Malaysia's growing digital economy.

Keywords: Customer experience, performance expectancy, effort expectancy, cognitive skills

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1.0 Introduction

The Fourth Industrial Revolution has significantly accelerated digital transformation, particularly in Malaysia's retail sector, where the rise of digitally savvy consumers has driven the growth of online shopping. With the e-commerce market expected to expand from USD 7.11 billion in 2023 to USD 14.32 billion by 2028, Malaysia is embracing digital platforms as a central mode of retail (Statista, 2023; Google & Temasek, 2019). This shift highlights the need to understand key factors that shape customer experience in e-commerce. Performance expectancy and effort expectancy have emerged as established determinants, representing the perceived benefits and ease of use, respectively (Venkatesh et al., 2012; Tan & Ooi, 2021). However, the role of cognitive skills such as attention and problem-solving remains underexplored. These skills are crucial in helping consumers manage high levels of online information, avoid decision fatigue, and interact effectively with complex interfaces (Chen et al., 2020; Lee & Lee, 2018). While UTAUT-based models have highlighted various psychological and contextual variables, they often overlook individual cognitive variability. This study addresses that gap by incorporating cognitive skills as a mediating factor within the UTAUT2 framework.

In Malaysia, cognitive skills are increasingly recognized as essential to navigating e-commerce platforms, particularly among young adults who are the most active online shoppers (Nguyen et al., 2021). Justifying this focus, cognitive skills can influence how users process performance and effort-related expectations in digital environments, yet existing models rarely account for these individual

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differences. This study examines how cognitive skills mediate the relationship between performance expectancy, effort expectancy, and customer experience using UTAUT2. By integrating recent empirical insights, the study aims to provide recommendations for enhancing customer satisfaction and user experience in Malaysia's digital economy (Smith et al., 2020; Lai et al., 2020).

2.0 Literature Review

2.1 Online Shopping and Consumer Behaviour

The rapid expansion of e-commerce in Malaysia mirrors global trends, positioning online shopping as a transformative force within the retail sector. As the Malaysian e-commerce market is projected to grow from USD 7.11 billion in 2023 to USD 14.32 billion by 2028 (Google & Temasek, 2019), understanding the key factors influencing consumer behaviour in digital marketplaces has become increasingly critical. Consumer behaviour in online shopping is driven by multiple determinants, including performance expectancy, effort expectancy, and cognitive skills (Chen et al., 2020; Lee & Lee, 2018). These factors are pivotal in shaping customer experience and satisfaction while promoting continued engagement with e-commerce platforms (Al-Gahtani & Al-Zahrani, 2023).

However, recent studies suggest that individual cognitive capacity remains an overlooked variable in consumer decision-making models. While emotional, social, and trust-related mediators have been commonly explored, few models explicitly account for how users process and respond to digital complexity. Hussain and Daud (2023) found that higher digital literacy levels significantly enhanced cognitive engagement during online shopping, especially among Malaysian youth, suggesting that cognitive variability is a key factor in digital consumer behaviour. As Malaysia transitions further into the digital economy, exploring these behavioural drivers, including cognitive skills, offers valuable insights for academia and industry to optimize online shopping experiences.

2.2 Relationship between performance expectancy and cognitive skills

Performance expectancy is defined as the perceived benefits consumers anticipate from using online shopping platforms and plays a significant role in determining online shopping behaviours (Venkatesh et al., 2012). It reflects the extent to which consumers believe that using an online platform will lead to gains in productivity and efficiency. Prior studies have shown that higher performance expectancy results in greater customer satisfaction and increased likelihood of repeated platform usage (Choi & Kim, 2022). This expectation is particularly relevant in the e-commerce environment, where consumers seek ease and efficiency in their shopping experiences. Choi and Kim (2022) further demonstrated that consumers with greater cognitive skills can better manage the complexity of online platforms, thereby enhancing their overall shopping experience. Consequently, performance expectancy emerges as a crucial predictor of positive cognitive skills in online environments.

Although performance expectancy has been well established in prior UTAUT research, the potential interaction between this construct and cognitive functioning remains underexplored. Tan, Ooi, and Chong (2023) emphasized that consumers' cognitive processing, particularly trust evaluation and usability perception, significantly moderates their acceptance of mobile commerce platforms in Malaysia. This study seeks to address that by framing cognitive skills not merely as outcomes but as active mediators of perceived platform benefits. This study examines the relationship between performance expectancy and cognitive skills, leading to the formulation of the following hypothesis:

H1: Performance expectancy affects cognitive skills among online shopping consumers

2.3 Relationship between Effort Expectancy and Cognitive Skills

Effort expectancy, or the perceived ease of use associated with online platforms, is another determinant closely linked to consumer satisfaction and engagement. According to Venkatesh et al. (2012), effort expectancy significantly impacts how consumers perceive the usability of digital technologies, particularly in online shopping contexts. Reducing the cognitive effort required to navigate online platforms has been shown to enhance user satisfaction and foster greater engagement. For instance, Bilgihan and Bujisic (2014) found that intuitive design and user-friendly interfaces reduce cognitive load, facilitating smoother transaction processes.

Effort expectancy also directly influences cognitive skills, enabling users to interact more effectively with online environments and improving the overall customer experience. Yet, the reliance on perception-based measures may obscure the underlying cognitive dynamics at play. While perceived ease of use is important, actual user engagement is moderated by how effectively individuals can comprehend and process platform elements. Future studies could consider integrating observational or experimental methods to validate these relationships. This linkage suggests that effort expectancy plays a dual role in shaping user satisfaction while reinforcing cognitive engagement during online shopping activities. Therefore, this study examines the relationship between effort expectancy and cognitive skills, leading to the following hypothesis:

H2: Effort expectancy affects cognitive skills among online shopping consumers

2.4 Relationship between Cognitive Skills and Customer Experience

Cognitive skills such as attention, memory, and problem-solving are increasingly recognized as critical mediators in the relationship between performance expectancy, effort expectancy, and customer experience (Bigne et al., 2019; Chen et al., 2021). In the digital marketplace, consumers often face complex decisions, multiple product options, and a constant influx of information. Cognitive skills help consumers navigate these challenges by enabling them to process information more efficiently, make informed decisions, and mitigate risks such as fraud during transactions.

Despite the growing recognition of cognitive skills' importance, their mediating role in online shopping experiences remains underexplored. Few existing studies have positioned cognitive traits as a lens to explain user experience disparities, especially within established adoption frameworks like UTAUT2. This creates a theoretical gap that this study seeks to fill. This study addresses this gap by examining how cognitive skills moderate the effects of performance and effort expectancy on customer experience in online shopping environments. Recent research emphasizes that consumers with stronger cognitive skills are better equipped to handle complex digital platforms, leading to more favourable shopping outcomes (Lee & Lee, 2018). Based on this, the following hypothesis is developed:

H3: Cognitive skills affect the customer experience of online shopping

2.5 Conceptual framework

Figure 1 presents the conceptual framework developed for this study. The two independent variables, performance expectancy (PE) and effort expectancy (EE), are measured about the mediating variable, cognitive skills (CS). The dependent variable in the framework is customer experience (CE) within the context of online shopping.

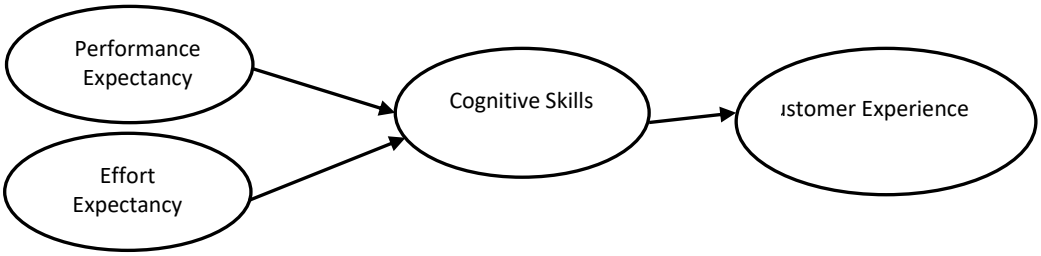

Figure 1. Conceptual Framework

3.0 Research methodology

3.1 Introduction

This study employs a quantitative approach under a correlational research design to investigate the mediating role of cognitive skills in the relationship between performance expectancy, effort expectancy, and customer experience within the context of online shopping in Malaysia. A mono-method, cross-sectional design was selected to capture data at a single point in time, allowing for hypothesis testing within a theory-driven model. Grounded in the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) framework, the research focuses on how cognitive skills influence online shopping behaviour. Pilot data were collected through a structured online questionnaire, and the relationships between the constructs were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM). This methodological approach ensures a robust examination of the variables while accounting for the mediating effects of cognitive skills. The use of PLS-SEM is particularly appropriate given the small sample size and the exploratory nature of this study.

3.2 Research Design

The study adopts a cross-sectional, mono-method quantitative research design, utilizing an online survey to collect data from Malaysian online shoppers at a single point in time. The structured questionnaire employed validated scales adapted from prior studies to measure the key constructs: performance expectancy, effort expectancy, cognitive skills, and customer experience (Venkatesh et al., 2012). Cognitive skills were measured using perception-based self-assessments focusing on attention, information processing, and problem-solving. This method aligns with prior studies in digital consumer behaviour, where subjective perceptions are considered valid proxies for cognitive functioning (Hussain & Daud, 2023). While efficient for large-scale data collection, this approach introduces limitations due to its reliance on self-reported cognitive ability, which may not fully reflect actual behaviour under digital complexity.

3.3 Population and Sampling

The target population for this study includes online shoppers in Malaysia who have engaged in e-commerce activities within the past 12 months. Due to logistical constraints associated with online data collection, purposive sampling was employed. A total of 55 usable responses were obtained for this pilot analysis. Although the sample size is relatively small, PLS-SEM is particularly suitable for exploratory research involving smaller samples and complex models. This method is effective in providing robust results even when traditional sample size requirements are not met, ensuring the study meets its exploratory objectives. However, the relatively homogenous demographic composition may limit generalizability, and future studies should aim to include broader and more diverse population segments.

3.4 Data Collection

Data collection was conducted via an online questionnaire distributed through various social media platforms and email lists. The survey instrument was designed to measure the constructs of performance expectancy, effort expectancy, cognitive skills, and customer experience using Likert scales ranging from 1 ("strongly disagree") to 5 ("strongly agree"). The questionnaire was divided into sections: the first section included screening questions related to online shopping behaviour, the second section measured the key study variables, and the third section collected demographic information such as gender, age, and income level. The survey was designed to ensure

clarity and simplicity to maximize respondent engagement and minimize errors. Ethical clearance was obtained, and all responses were collected anonymously with informed consent.

3.5 Data Analysis

The collected data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM), a robust technique suited for the exploratory nature of this study and for analysing complex relationships among latent variables. Reliability and validity of the constructs were assessed using factor loadings, Cronbach's alpha, and composite reliability. Once the measurement model was validated, the structural model was analysed to test the study's hypotheses, specifically the mediating role of cognitive skills in the relationship between performance expectancy, effort expectancy, and customer experience. Bootstrapping with 10,000 resamples was used to test path significance and mediation effects, following the guidelines by Hair et al. (2017).

4.0 Findings and Discussion

4.1 Respondents Profile

Table 1 presents the demographic characteristics of the 55 respondents. The sample is predominantly female, comprising 65.5% of the respondents, while males account for 34.5%. The age group of 18-24 years old makes up the entirety of the sample (100%), indicating that the study focused exclusively on young adults. In terms of ethnicity, the majority of the respondents were identified as Malay (94.5%), with only 5.5% belonging to other ethnic groups. Regarding individual income, 85.5% of the respondents reported their income as "not applicable," which may suggest that they are still financially dependent or not in the workforce yet, and the remaining respondents, 12.7% reported earning RM1000 and below, while only 1.8% indicated an income of RM1001 to RM2500.

Table 1. Demographic Characteristics of Respondents

Characteristics	Items	Frequency	%
Gender	Male Female	19 36	34.5% 65.5%
Age	18 - 24 years old	55	100%
Ethnicity	Malay Other	52 3	94.5% 5.5%
Individual income	RM1000 and below Rm1001 to RM2500 Not applicable	7 1 47	12.7% 1.8% 85.5%

4.2 Assessment of the Reflective Measurement Model

The data from the questionnaire were analysed using Smart PLS, following a three-step approach: the evaluation of the measurement model, the structural model, and the hierarchical model. Table 2 illustrates the results of the measurement model, which examines the relationships between items and constructs, while the structural model investigates the relationships between the exogenous and endogenous constructs within the research model. To assess internal consistency, reliability, and convergent validity of the measurement model, the loadings, Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE) were evaluated. According to Hair et al. (2017), loading values should exceed 0.6, CR values should be above 0.7, and AVE should be at least 0.5 to confirm convergent validity. Table 2 presents the results of the measurement model assessment, showing that the loadings for the constructs ranged from 0.59 to 0.88, with CR values ranging from 0.808 to 0.916 and AVE values between 0.519 and 0.732. Although some items, such as CE3 (0.59) and CE4 (0.607), exhibited slightly lower loadings, the overall constructs demonstrated satisfactory reliability and convergent validity, with most CR and AVE values exceeding the recommended thresholds.

Once internal consistency, reliability, and convergent validity were confirmed, discriminant validity was assessed using the heterotrait-monotrait ratio of correlations (HTMT) criterion. Table 3 illustrates that all HTMT values were below the recommended threshold of 0.90 (Hair et al., 2017), indicating that the constructs were distinct from one another and that discriminant validity was achieved. For example, the HTMT value between Customer Experience (CE) and Cognitive Skills (SI) was 0.586, well below the 0.90 threshold, demonstrating a clear distinction between these constructs.

Table 2. The measurement model assessment

Constructs	Customer Experience (CE)	Effort Expectancy (EE)	Performance Expectancy (PE)	Cognitive Skills (SI)
Customer Experience (CE)				0.586
Effort Expectancy (EE)				0.91
Performance Expectancy (PE)	0.841	0.816		0.878

Table 3. Discriminant validity of the measurement model using HTMT

Constructs	Measurement items	Loadings	Cronbach's	CR	AVE
Customer Experience (CE)	CE1	0.765	0.687	0.808	0.519
	CE2	0.88			
	CE3	0.59			
	CE4	0.607			
Effort Expectancy (EE)	EE1	0.858	0.878	0.916	0.732
	EE2	0.828			
	EE3	0.861			
	EE4	0.875			
Performance Expectancy (PE)	PE1	0.814	0.756	0.845	0.578
	PE2	0.651			
	PE3	0.802			
	PE4	0.762			
Cognitive Skills (SI)	SI1	0.869	0.83	0.887	0.663
	SI2	0.863			
	SI3	0.8			
	SI4	0.715			

4.2.1 Assessment of the Structural Measurement Model

After validating the measurement model, the structural model was analysed to test the three hypotheses (H1, H2, and H3). Following the guidelines set by Hair et al. (2017), the analysis examined the direction and significance of the beta values, t-values, and p-values to assess the relationships proposed in the hypotheses. A bootstrapping procedure with 10,000 resamples was conducted to test the direct effects and ensure the robustness of the findings. As presented in Table 4, all three hypotheses were supported. Hypothesis H1, which proposed that cognitive skills positively influence customer experience, was confirmed, showing a significant positive relationship ($\beta = 0.471$, $t = 4.587$, $p < 0.001$). This finding suggests that cognitive engagement, such as attention, memory, and problem-solving, plays a strong and meaningful role in shaping users' satisfaction and experience in online shopping environments. Hypothesis H2, which posited a positive relationship between effort expectancy and cognitive skills, was also supported and demonstrated the strongest effect in the model ($\beta = 0.585$, $t = 4.913$, $p < 0.001$). This result indicates that ease of use strongly enhances users' cognitive engagement during their online shopping process, aligning with previous research on usability and consumer interaction. In contrast, Hypothesis H3, which examined the effect of performance expectancy on cognitive skills, was supported but revealed a notably weaker effect size ($\beta = 0.304$, $t = 2.236$, $p = 0.013$). This somewhat unexpected finding suggests that although perceived usefulness contributes to cognitive engagement, it may be less influential than ease of use in the Malaysian online shopping context. One possible explanation is that younger digital users may value intuitive interaction more than productivity-related outcomes when evaluating online platforms.

Table 5 provides the R-squared and F-squared values for the endogenous variable, cognitive skills. The R-squared value of 0.664 indicates that 66.4% of the variance in cognitive skills can be explained by customer experience, effort expectancy, and performance expectancy. According to Cohen's (1989) criteria, this indicates that the structural model has substantial explanatory power. As for f square, which measures the impact of each exogenous construct on the R square when excluded from the model, the results in Table 6 show that both effort expectancy and performance expectancy have small effect sizes ($f^2 = 0.006$). Despite the small individual effect sizes, their statistical significance confirms that both constructs contribute meaningfully to the model. Taken together, the results underscore the robustness of the model and provide empirical support for the mediating role of cognitive skills in online shopping behaviour.

Table 4. The structural model assessment

Hypothesis	Relationship	Beta	Std Deviation	t value	p value	Decision
H1	Cognitive Skills – Customer Experience	0.471	0.103	4.587	0	SUPPORTED
H2	Effort Expectancy – Cognitive Skills	0.585	0.119	4.913	0	SUPPORTED
H3	Performance Expectancy – Cognitive Skills	0.304	0.136	2.236	0.013	SUPPORTED

Table 5. Result of R-squared and F-squared

Constructs	R square	f square	Decision
Customer Experience	0.664		
Effort Expectancy (EE)		0.006	Small
Performance Expectancy (PE)		0.006	Small

5.0 Discussion & Recommendation

This study underscores the critical role of cognitive skills in mediating the relationships between performance expectancy, effort expectancy, and customer experience within the Malaysian online shopping context, analysed through the UTAUT2 framework. The findings reveal that cognitive skills, particularly problem-solving and information processing, significantly enhance customer experience by enabling more effective navigation of online platforms, consistent with previous research emphasizing the impact of well-developed cognitive abilities on positive online shopping outcomes (Chen et al., 2020). Performance expectancy was found to positively influence cognitive skills, with consumers who perceive online platforms as productivity-enhancing demonstrating greater cognitive engagement, resulting in smoother and more satisfying shopping experiences (Choi & Kim, 2022). However, the effect size for performance expectancy was weaker than anticipated, suggesting that perceived usefulness alone may not be a dominant factor for younger online shoppers in Malaysia. This highlights a shift in consumer priorities, where convenience and usability may outweigh performance benefits. Similarly, effort expectancy showed a strong positive relationship with cognitive skills, where user-friendly and intuitive platform designs reduced cognitive load and allowed consumers to focus on critical aspects of the shopping process (Bilgihan & Bujisic, 2014). This reinforces the value of interface design in driving cognitive engagement, particularly in visually dense or information-rich platforms.

Although the sample size of 55 respondents was relatively small, the use of Partial Least Squares Structural Equation Modelling (PLS-SEM) ensured robust analysis, accommodating small samples and complex models. However, the limited sample size may constrain generalizability, suggesting future studies should include larger and more diverse populations to enhance applicability. Moreover, the use of perception-based proxies for cognitive skills presents a limitation. Future research should incorporate objective or behavioural data (e.g., usability testing, eye-tracking) or apply mixed methods to triangulate findings. From a practical standpoint, the findings extend the UTAUT2 model by highlighting cognitive skills as a vital factor influencing online shopping behaviour, urging e-commerce platforms to optimize user interfaces, incorporate AI-driven personalized recommendations, and provide educational tools to enhance cognitive engagement. Developers should prioritize design elements that reduce decision fatigue, such as adaptive filtering, simplified layouts, and visual cues that aid attention. Policymakers are encouraged to implement consumer education programs focused on digital literacy and secure transaction practices to protect consumers in the evolving digital economy. Specifically, training initiatives should go beyond basic digital access and emphasize cognitive strategies for evaluating information, making informed choices, and avoiding fraud. Future research should explore demographic moderators, such as cultural differences and age, to deepen insights into how cognitive skills shape consumer behaviour in diverse online environments.

Paper Contribution to Related Field of Study

This study contributes to the field of digital consumer behaviour by extending the UTAUT2 framework to include cognitive skills as a mediating variable in the relationship between technology adoption factors and customer experience. By applying the model to the context of online shopping in Malaysia, the paper offers empirical evidence on how performance expectancy and effort expectancy influence experiential outcomes through cognitive engagement. These findings provide valuable insights for improving e-commerce platform design, enhancing digital literacy strategies, and strengthening theoretical understanding of cognitive factors in technology use.

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