

The Acceptance Factors of Self-Checkout Technology (SCT) Among Different Generations

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ABSTRACT

This study examines the factors influencing consumers' intention to use self-checkout technology (SCT) among Gen-Z, Millennials, and Gen-X in the Malaysian retail context. Grounded in the Technology Acceptance Model (TAM), the study extends the model by incorporating perceived enjoyment, technology anxiety, and technology exposure, with generational cohort examined as a moderating variable. A quantitative research design was employed using a structured questionnaire administered to 102 respondents with prior experience using self-checkout technology. Data were analysed using descriptive statistics, exploratory factor analysis, reliability testing, multiple regression, and moderation analysis via Hayes' Process Macro. The findings reveal that perceived enjoyment and technology exposure positively influence intention to use self-checkout technology, while technology anxiety has a significant negative effect. Perceived usefulness and perceived ease of use were not found to be significant factors, suggesting that these factors are viewed as basic expectations rather than key motivators. Moderation analysis indicates that generational cohort does not significantly moderate most relationships, although marginal moderation effects were observed for perceived enjoyment and technology exposure. Overall, the results suggest that self-checkout technology adoption is driven more by experiential and familiarity-related factors than by age considerations. The study contributes to technology acceptance literature by highlighting the growing importance of hedonic and psychological factors in retail self-service technologies and provides practical insights for retailers seeking to enhance self-checkout technology adoption across different age groups.

Keywords

Self-checkout Technology; TAM; Generation Cohorts; Retail; Malaysia

Introduction

Over the past decade, the retail sector has experienced significant digital transformation driven by advancements in automation and self-service technologies. One of the most prominent innovations in this transformation is self-checkout technology (SCT), which has become increasingly common in modern retail environments (Garaus et al., 2021; Inman & Nikolova, 2020). Self-checkout systems allow customers to independently complete purchase transactions by scanning items, processing payments, and finalizing purchases without direct assistance from store employees. This shift in transaction responsibility reflects retailers' efforts to improve service efficiency while responding to changing consumer expectations.

The adoption of self-checkout technology offers several operational and experiential benefits. From a retailer's perspective, self-checkout technology can reduce labour requirements (Dabholkar et al., 2003), minimize queue congestion (Demoulin & Djelassi, 2016), and improve transaction speed during peak shopping hours (Wang et al., 2012). For consumers, self-checkout technology provides greater autonomy (Meuter et al., 2005), flexibility (Childers et al., 2001), and perceived control over the purchasing process (Collier et al., 2015). As retail environments become more technology-oriented, such systems are increasingly viewed as a standard service option rather than a novelty (Zhang et al., 2019).

Despite its growing prevalence, consumer acceptance of self-checkout technology remains uneven and heavily segmented (Castro et al., 2023). While tech-savvy cohorts readily adopt self-checkout technology due to its convenience and efficiency, older or less technologically anxious demographics experience hesitation arising from usability concerns, fear of making mistakes, or discomfort when interacting with automated systems (Marzocchi et al., 2022). These mixed responses suggest that acceptance of self-checkout technology is influenced not only by functional considerations, but also by psychological and experiential factors, as highlighted in previous retail consumer research (Lee et al., 2020; Radomir & Moisesescu, 2022).

To better understand consumer adoption behaviour, the Technology Acceptance Model (TAM) developed by Davis (1989) has been widely used to explain individuals' intentions to use new technologies. However, the applicability of the original TAM framework may be limited in voluntary, consumer-facing contexts such as retail self-service technologies (Walker & Johnson, 2006), where usage decisions are influenced by personal preferences and emotional responses rather than organizational requirements (Nysveen et al., 2005).

In response to these limitations, prior studies have extended TAM by incorporating additional constructs that capture experiential and psychological dimensions of technology use. Factors such as perceived enjoyment, technology anxiety, and technology exposure have been found to play important roles in shaping consumers' willingness to engage with self-checkout systems (Elliott et al., 2022; Fernandes & Pedroso, 2021). These factors are particularly relevant in retail settings where customers are free to choose between traditional cashier-assisted checkout and self-service alternatives (Fernandes & Pedroso, 2021; Kokkinou & Cranage, 2013).

Furthermore, generational differences may influence how consumers perceive and interact with self-checkout technology. Generational cohorts such as Gen-Z, Millennials, and Gen-X differ in their levels of technological familiarity, comfort, and expectations. Younger generations, having grown up with digital technologies, may be more receptive to self-service systems, while older consumers may experience greater apprehension or require additional exposure before adoption.

However, a significant gap remains in the current literature: existing studies frequently treat consumer populations as monolithic or focus strictly on Western markets, leaving a critical shortage of empirical data regarding how these distinct generational cohorts react to self-checkout tech within developing, multi-cultural retail landscapes. This lack of granular understanding prevents retailers from addressing specific segment anxieties, resulting in underutilized infrastructure and uneven customer satisfaction.

Therefore, this study addresses this issue by directly examining the psychological and experiential factors influencing consumers' intention to use self-checkout technology among Gen-Z, Millennials, and Gen-X within the Malaysian retail context. By extending the Technology Acceptance Model to include perceived enjoyment, technology anxiety, and technology exposure, and evaluating the moderating role of generational cohorts, this study clarifies the precise barriers and drivers unique to each demographic. The findings resolve a lingering ambiguity in the literature and offer actionable segment-specific strategies for retailers seeking to optimize adoption across diverse consumer bases.

This study focuses on exploring how Gen-Z, Millennials, and Gen-X adopt self-checkout technology, aiming to investigate how the factors (e.g. perceived usefulness, perceived ease of use, perceived enjoyment, technology anxiety and technology exposure) influence them and how it could help retailers optimize the implementation of this technology. The research questions of the study are formulated as follows:

- i. To investigate the influence of factors (perceived usefulness, perceived ease of use, perceived enjoyment, technology anxiety and technology exposure) on the intention to use self-checkout technology.
- ii. To examine whether generational cohorts moderate the relationship between the influencing factors and the intention to use self-checkout technology.

Literature Review

Self-Checkout Technology in Retail

Self-checkout technology refers to retail systems that allow customers to complete purchase transactions independently using automated interfaces, without direct involvement from store personnel. These systems typically require customers to scan items, process payments, and finalize transactions on their own. Retailers have increasingly adopted self-checkout technology as part of broader digitalization strategies aimed at improving service efficiency, reducing operational costs, and enhancing customer flow, particularly during busy periods (Dabholkar, 1996; Meuter et al., 2000).

From a consumer perspective, self-checkout systems offer greater control over the transaction process and can reduce perceived waiting time. However, prior studies indicate that consumer reactions toward self-checkout technology are not uniform. While some customers appreciate the autonomy and convenience provided, others report frustration, confusion, or anxiety when interacting with automated checkout systems due to system errors or fear of making

mistakes (Meuter et al., 2003; Orel & Kara, 2014). These mixed responses highlight the importance of examining both functional and psychological factors when studying self-checkout technology adoption.

Additionally, self-checkout technology differs from many organizational technologies because its use is largely voluntary. Consumers often have the option to choose between self-service and cashier-assisted checkout, making acceptance dependent on personal preferences rather than mandatory requirements. As a result, researchers have emphasized the need to extend traditional technology acceptance frameworks to better capture experiential and emotional influences in retail self-service contexts (Curran & Meuter, 2005).

Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), proposed by Davis (1989), provides a theoretical foundation for understanding why individuals choose to adopt or reject new technologies. The model emphasizes users' cognitive evaluations of a system, suggesting that adoption decisions are shaped by beliefs about how the technology contributes to task performance and how difficult it is to use. These beliefs influence users' behavioural intentions, which subsequently determine actual system usage (Venkatesh & Davis, 2000).

Within the TAM framework, perceived usefulness reflects users' judgments about whether a technology enhances efficiency or effectiveness, while perceived ease of use captures perceptions of the effort required to operate the system. As illustrated in **Figure 1**, the model posits specific structural relationships between these core variables. Perceived ease of use directly influences perceived usefulness, as a system that is easier to manage is inherently viewed as more useful. Both variables jointly influence an individual's behavioral intention to use the technology, which serves as the direct determinant of actual system use. When users perceive a technology as both beneficial and easy to use, they are more likely to develop positive intentions toward its adoption. TAM has been widely applied across various domains due to its simplicity and strong explanatory capability.

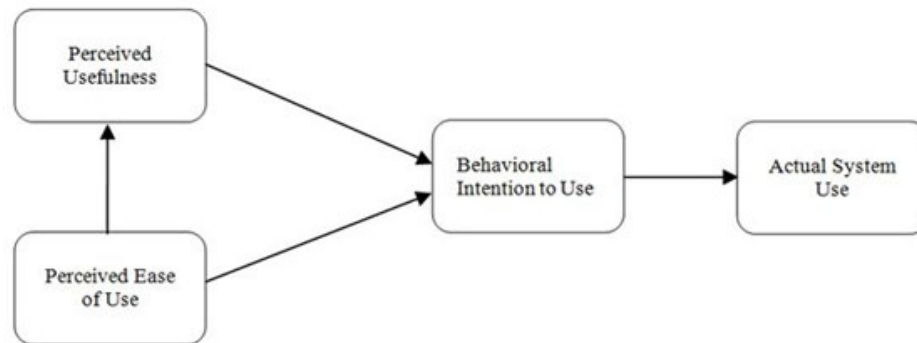


Figure 1. Technology Acceptance Model (TAM)

However, the original formulation of TAM was primarily developed for organizational and work-related environments, where technology adoption is often compulsory and driven by productivity goals. In such settings, users may adopt technologies regardless of personal preference. In contrast, self-checkout technology operates in a consumer-driven context, where usage is voluntary and users can freely choose between self-service and traditional cashier-assisted checkout options. This fundamental difference limits the ability of the original TAM constructs to fully explain consumer behaviour in retail self-service environments.

As self-checkout technology becomes more prevalent, consumers may no longer evaluate it solely based on functional benefits or usability. Instead, emotional responses, confidence levels, and prior experiences increasingly influence adoption decisions. For example, consumers may avoid self-checkout systems despite recognizing their usefulness if they feel anxious or uncomfortable using the technology. Similarly, familiarity with digital systems can enhance confidence and reduce resistance toward adoption.

Recognizing these limitations, researchers have extended TAM by integrating additional constructs that capture experiential and psychological influences on technology use. Incorporating variables such as perceived enjoyment,

technology anxiety, and technology exposure allows for a more comprehensive understanding of adoption behaviour in voluntary, consumer-facing contexts. These extensions improve the model's relevance by accounting for both rational evaluations and emotional responses that shape consumers' intention to use self-checkout technology (Venkatesh et al., 2012).

Table 1 Summary Table of 20 Previous Studies

Independent Variable	Frequency of Appearance (Significant Effect)
Technology Acceptance Model (TAM)	
Perceived Usefulness	9
Perceived Ease of Use	8
External Factor	
Perceived Enjoyment	5
Technology Anxiety	4
Technology Exposure	4
Other Variables	≤ 3

Notes: The 20 studies included in the review are: Tsai and Geetha (2019), Khalufi and Shah (2022), Hamsani et al. (2017), Ibrahim et al. (2025), Chua and Talib (2017), Cebeci et al. (2019), Hashim et al. (2023), Rashid et al. (2024), Aguirre Reid et al. (2024), Jumbri et al. (2024), Khalufi et al. (2022), Ujang et al. (2016), Jamil et al. (2019), Saleh (2016), Murad et al. (2024).

To justify the selection of variables for this research, a comprehensive review of existing literature was conducted. **Table 1** provides a summary of 20 previous studies, highlighting the frequency with which specific independent variables demonstrated a statistically significant effect on technology adoption. As shown in the table, core Technology Acceptance Model (TAM) variables namely Perceived Usefulness and Perceived Ease of Use remain the most prominently supported factors across the literature. Additionally, external psychological and experiential factors such as Perceived Enjoyment, Technology Anxiety, and Technology Exposure frequently emerge as critical determinants, whereas other miscellaneous variables appear far less consistently.

In line with this perspective, the present study adopts an extended TAM framework to examine consumers' intention to use self-checkout technology across different generational cohorts. By integrating the highly relevant experiential and psychological factors identified in **Table 1** and assessing the moderating role of generational cohort, this study aims to provide deeper insights into the mechanisms underlying self-checkout technology acceptance in the Malaysian retail context.

Perceived Usefulness

Perceived usefulness reflects the extent to which consumers believe that using self-checkout technology improves their shopping performance. In retail settings, this perception often relates to completing transactions more efficiently, reducing waiting time, and increasing convenience during the checkout process. When consumers perceive self-checkout systems as beneficial in accomplishing their shopping tasks, they are more likely to develop a favourable intention toward using the technology (Davis, 1989).

Empirical studies have consistently identified perceived usefulness as an important determinant of technology adoption. For example, Tsai and Geetha (2019) found that perceived usefulness significantly influenced consumers' intention to use self-service kiosks in Malaysian fast-food outlets. Similarly, Saleh (2016) reported that perceived usefulness played a dominant role in shaping attitudes toward self-checkout technology adoption in Malaysian retail environments. Recent studies by Aguirre Reid et al. (2024) confirm that modern consumers' perceived utility and performance expectations remain primary drivers for interacting with advanced retail self-service systems. Furthermore, contemporary research exploring fully automated retail spaces underlines that perceived usefulness acts as a foundational cognitive bridge directly driving behavioral intentions (Wongyai et al., 2024). Based on the discussion, this study hypothesises that:

H1: Perceived usefulness positively influences the intention to use self-checkout technology.

Perceived Ease of Use

Perceived ease of use refers to consumers' beliefs regarding the effort required to operate self-checkout technology. Systems that are intuitive, user-friendly, and easy to navigate are more likely to encourage adoption, as they reduce

frustration and increase users' confidence. Conversely, complex interfaces or unclear instructions may discourage consumers from using self-checkout systems due to fear of making errors (Khalufi & Shah, 2022).

Prior research has demonstrated that perceived ease of use positively influences consumers' acceptance of self-service technologies. Hamsani et al. (2017) found that ease of use significantly affected customers' willingness to use self-service kiosks, suggesting that simplicity and clarity are critical factors in promoting adoption, particularly among users with limited technological confidence. This finding continues to receive strong support in contemporary literature; for instance, recent studies by Aguirre Reid et al. (2024) confirm that seamless user interfaces and reduced cognitive friction remain instrumental in driving continuous self-checkout utilization. Similarly, recent work by Wongyai et al. (2024) demonstrates that eliminating operational complexities directly influences initial interaction choices and overall adoption rates in fast-paced retail landscapes. Based on prior work, it is hypothesised that:

H2: Perceived ease of use positively influences the intention to use self-checkout technology.

Perceived Enjoyment

Perceived enjoyment represents the degree of pleasure or satisfaction consumers experience when using self-checkout technology. Unlike utilitarian factors, enjoyment captures the emotional value derived from interacting with the system. When consumers find the checkout process engaging or enjoyable, they are more likely to use the technology voluntarily, even when alternative options are available (Aguirre Reid et al., 2024).

In the context of self-checkout technology, enjoyable features such as interactive interfaces, smooth system responses, and a sense of control can enhance users' overall experience. Generational differences may influence how enjoyment affects adoption, as younger consumers who frequently interact with digital technologies may place greater value on engaging and seamless user experiences. Prior studies have shown that technologies perceived as enjoyable tend to achieve higher acceptance rates across consumer groups (Ibrahim et al., 2025). Thus, it is hypothesised that:

H3: Perceived enjoyment positively influences the intention to use self-checkout technology.

Technology Anxiety

Technology anxiety refers to the feelings of apprehension or discomfort individuals experience when using technological systems. Consumers who exhibit higher levels of technology anxiety may fear making mistakes, encountering technical problems, or feeling embarrassed during public interactions with self-checkout systems. These concerns can significantly reduce their willingness to engage with self-service technologies.

In retail settings, technology anxiety can be particularly influential because self-checkout interactions often occur in visible environments where users feel observed by others. Research has shown that technology anxiety negatively affects intention to use self-checkout and other self-service technologies, acting as a psychological barrier to adoption (Lee & Coughlin, 2015; Saleh, 2016). Thus, it is hypothesised that:

H4: Technology anxiety negatively influences the intention to use self-checkout technology.

Technology Exposure

Technology exposure refers to an individual's prior experience and familiarity with digital technologies. Consumers who are frequently exposed to technology tend to develop greater confidence and competence when interacting with new systems. This familiarity reduces uncertainty and lowers resistance toward adopting self-checkout technology. Previous studies indicate that higher levels of technology exposure are associated with more positive attitudes and stronger intentions to use self-service technologies. Weijters et al. (2007) and Turner (2015) found that individuals with extensive experience using digital systems were more likely to perceive self-checkout technology as intuitive and less intimidating. Khalufi and Shah (2022) further confirmed that technology exposure positively influences consumers' intention to use self-service technologies in retail environments. Based on those findings, it is hypothesised that:

H5: Technology exposure positively influences the intention to use self-checkout technology.

Generational Cohort

Generational cohort refers to the categorization of individuals into age-based groups that share similar life experiences, technological exposure, and social influences. Commonly examined cohorts include Gen-Z (born 1997–2012), Millennials (born 1981–1996), and Gen-X (born 1965–1980). These generations differ in their familiarity with digital technologies, openness to innovation, and preferences for technology-mediated interactions. Younger generations, particularly Gen-Z and Millennials, are often described as digital natives who are comfortable using advanced technologies in daily life. As a result, they may exhibit stronger relationships between acceptance factors and intention to use self-checkout technology. In contrast, Gen-X consumers may demonstrate more cautious adoption behaviour, especially if technology anxiety is present. Examining generational cohort as a moderating variable allows researchers to assess whether acceptance factors operate differently across age groups (Williams et al., 2012; Gurunathan & Lakshmi, 2024). The followings are hypothesised based on past literature findings:

H6: The relationships between perceived usefulness and the intention to use self-checkout technology are moderated by the generational cohorts (Gen-Z, Millennials, and Gen-X).

H7: The relationships between perceived ease of use and the intention to use self-checkout technology are moderated by the generational cohorts (Gen-Z, Millennials, and Gen-X).

H8: The relationships between perceived enjoyment and the intention to use self-checkout technology are moderated by the generational cohorts (Gen-Z, Millennials, and Gen-X).

H9: The relationships between technology anxiety and the intention to use self-checkout technology are moderated by the generational cohorts (Gen-Z, Millennials, and Gen-X).

H10: The relationships between technology exposure and the intention to use self-checkout technology are moderated by the generational cohorts (Gen-Z, Millennials, and Gen-X).

Research Framework

Drawing upon the insights from the reviewed literature, a conceptual research model is proposed to explore the generational differences in the acceptance of self-checkout technology. As illustrated in Figure 2, the model incorporates key factors that influence the intention to use self-checkout technology drawn from the Technology Acceptance Model (Davis, 1989), which are perceived usefulness and perceived ease of use. To provide a more comprehensive overview of consumer behavior, this baseline framework is extended with additional significant factors tested and reviewed among previous studies: perceived enjoyment, technology anxiety, and technology exposure.

In this structural framework, these five core constructs serve as independent variables hypothesized to directly influence the dependent variable, namely the Intention to Use Self-Checkout Technology (SCT). Furthermore, the generational cohorts (Gen-Z, Millennials, and Gen-X) are introduced as a moderating variable. As visually represented by the dashed directional arrows intersecting the primary paths in Figure 2, this moderator is utilized to examine whether an individual's generational cohort significantly alters the strength or direction of the relationship between each respective influencing factor and the ultimate intention to use self-checkout technology.

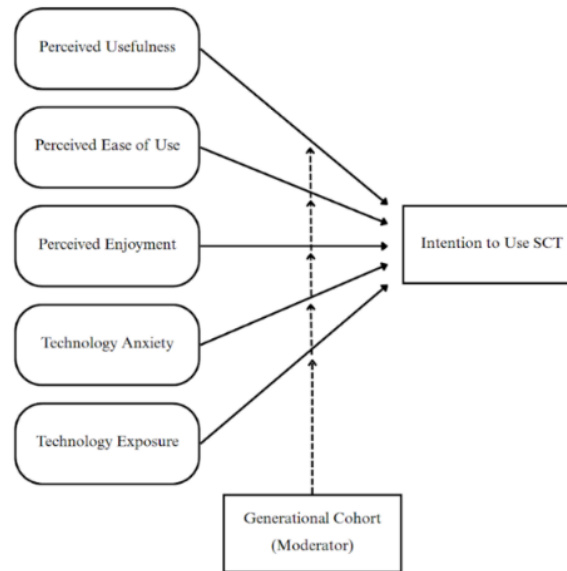


Figure 2. Conceptual Framework

Methods

Research Design

This study employed a quantitative research design to examine factors influencing consumers' intention to use self-checkout technology in the Malaysian retail context. A cross-sectional approach was adopted, as data were collected at a single point in time to capture respondents' perceptions and behavioural intentions. This design is appropriate for examining relationships between variables and identifying patterns of technology acceptance among different consumer groups.

Population and Sampling

The target population consisted of Malaysian consumers from three generational cohorts; Gen-Z, Millennials, and Gen-X who had prior experience using self-checkout technology in retail settings. A non-probability sampling technique was applied, as respondents were selected based on their accessibility and eligibility criteria rather than random selection. To determine an adequate sample size, established guidelines for multivariate analysis were followed. Hair et al. (2019) suggest that a sufficient number of observations should be obtained relative to the number of predictor variables to ensure statistical power. Given that this study examined five independent variables, a minimum of 100 respondents was considered appropriate. Additionally, moderation analysis using Hayes' PROCESS Macro requires an adequate number of observations within each subgroup. Accordingly, a minimum of 30 respondents per generational cohort was targeted to support parametric testing (Hogg & Tanis, 2009). A total of 102 valid responses were collected, satisfying these requirements. This sample size was justified based on Green's (1991) rule of thumb for multiple regression, which suggests a minimum $N \geq 50 + 8m$ (where m is the number of predictors). With 5 independent variables, the minimum required sample is 90 ($50 + 40$), making 102 respondents sufficient for robust regression and moderation analysis.

Data Collection

Data were collected using a structured online questionnaire administered via Google Forms. The survey link was distributed through online communication platforms such as WhatsApp and Telegram to reach respondents from the targeted generational groups. Ethical considerations were observed throughout the research process. Respondents were informed of the purpose of the study, assured of confidentiality, and notified that their participation was voluntary. No personally identifiable information was collected, and all responses were used solely for academic purposes.

Furthermore, respondents were screened to ensure that they had prior experience using self-checkout technology. Responses that did not meet the eligibility criteria were excluded from the analysis.

Measurement Instruments

The questionnaire comprised two main sections. The first section collected demographic information, including gender, age group (generational cohort), and occupation. The second section measured the study constructs: perceived usefulness, perceived ease of use, perceived enjoyment, technology anxiety, technology exposure, and intention to use self-checkout technology. All measurement items were adapted from validated instruments in prior studies to ensure content validity. Responses were recorded using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) as it aligns natively with the source literature from which the current TAM and self-service items were adapted, ensuring baseline psychometric consistency. This scaling method is consequently preferred in consumer technology acceptance research due to its capacity to increase response rates and accuracy while effectively capturing respondents' genuine perceptions.

Pilot Test

A pilot test was conducted involving 30 respondents who matched the target demographic criteria to assess the reliability of the measurement instruments used in this study. Each construct consisted of three items, and reliability was evaluated using Cronbach's Alpha. The results, as shown in Table 2, indicate that all constructs achieved Cronbach's Alpha values above 0.85. According to Nunnally and Bernstein (1994), a Cronbach's alpha value of 0.70 serves as the foundational threshold for acceptable internal consistency reliability in social science research. Furthermore, the higher alpha coefficients obtained in this pilot test (ranging from 0.858 to 0.926) exceed this standard, satisfying the more stringent criteria outlined by Hair et al. (2010), who classify alpha values above 0.80 as indicative of good internal consistency, and George and Mallery (2003), who categorize values above 0.90 as excellent. These robust indicators justify that the adapted instruments are highly reliable and psychometrically sound for subsequent full-scale deployment.

Table 2 Pilot Test Result

Variable	Number of Items	Cronbach's Alpha
Perceived Usefulness	3	0.886
Perceived Ease of Use	3	0.858
Perceived Enjoyment	3	0.924
Technology Anxiety	3	0.926
Technology Exposure	3	0.865
Intention to Use Self-checkout Technology	3	0.894

Data Analysis Techniques

Data analysis was conducted using Statistical Package for the Social Sciences (SPSS) version 30. Descriptive statistics were first employed to summarize respondents' demographic profiles and overall perceptions of self-checkout technology. Preliminary data screening was performed to identify incomplete or invalid responses, assess missing values, and detect potential outliers. Standardised scores were examined to ensure that all values fell within acceptable ranges for parametric analysis.

Exploratory factor analysis was conducted to assess the underlying structure of the measurement items and to confirm construct validity. Items with weak loadings or substantial cross-loadings were removed to improve the clarity of the factor structure. Reliability analysis was subsequently performed using Cronbach's alpha to evaluate internal consistency of each construct. In addition, multiple regression analysis was then used to examine the direct effects of perceived usefulness, perceived ease of use, perceived enjoyment, technology anxiety, and technology exposure on intention to use self-checkout technology. To test the moderating effect of generational cohort, moderation analysis was conducted using Hayes' PROCESS Macro (Model 1). This approach allowed for the assessment of interaction effects between generational cohort and each independent variable while controlling for other predictors in the model.

Data Analysis and Results

Preliminary Data Analysis

Before conducting the main statistical analyses, a series of preliminary data screening procedures were performed to ensure the quality and suitability of the dataset. Data cleaning was first undertaken to identify and remove incomplete, duplicate, or invalid responses. Responses that did not meet the screening criteria, such as respondents without prior experience using self-checkout technology or questionnaires with substantial missing information, were excluded from further analysis. In this case, a total of 3 responses were excluded. These respondents did not meet the study's criteria as they lacked prior experience with self-checkout technology, making their input unsuitable for this research.

The dataset was then examined for missing values. As the online questionnaire (Google Forms) required mandatory responses for all key items, the occurrence of missing data was minimal. Outlier detection was subsequently conducted to identify extreme or abnormal values that could potentially distort statistical results. Standardised scores (Z-score) were examined to ensure that all values fell within acceptable ranges (between ± 3.29). No severe outliers were detected that warranted removal from the dataset. Overall, the data screening process confirmed that the final dataset was clean, complete, and suitable for parametric statistical analyses. These preliminary procedures enhanced the reliability and validity of subsequent analyses, including regression and moderation testing.

Demographic Analysis

A total of 102 responses were collected through the online survey via social media platforms like WhatsApp and Telegram. The demographic profile categorized respondents by gender, age (generational cohort), and occupation to ensure a representative sample for the analysis of self-checkout technology acceptance factors.

Table 3 Frequency and Percentage of Respondents' Demographic Characteristics

Demographic Profiles		Frequency (n=102)	Percentage (%)
Gender	Male	53	52
	Female	49	48
Age (Generation)	13 to 28 (Gen-Z)	37	36.3
	29 to 44 (Millennials)	32	31.4
	45 to 60 (Gen-X)	33	32.4
Occupation	Student	30	29.4
	Working	17	16.7
	Unemployed	55	53.9

Factor Analysis

To evaluate the construct validity and factorial structure of the measurement scale, a rigorous Exploratory Factor Analysis (EFA) procedure was executed within SPSS version 30. The extraction method utilized was Principal Component Analysis (PCA), which is mathematically designed to reduce data variance into a manageable set of linear components. To achieve clear differentiation and enhance factor interpretability, an orthogonal rotation method, specifically Varimax rotation with Kaiser Normalization, was applied.

Varimax rotation was selected because it minimizes the complexity of the factors by maximizing the variance of each factor's loading coefficients, ensuring that each item correlates strongly with only one specific construct, thereby minimizing cross-loadings. Factor retention was governed by Kaiser's criterion (retaining eigenvalues > 1.0) and visual inspection of the scree plot. Items were subjected to a strict retention threshold where primary factor loadings had to exceed 0.50, and any item exhibiting a cross-loading higher than 0.40 on secondary factors was slated for systematic elimination.

The initial factor matrix revealed significant cross-loadings and weak item placements that required structural refinement to ensure statistical validity. Regarding Perceived Ease of Use, item PEOU1 showed a triple cross-loading across three distinct components (0.342, 0.457, and 0.538), while PEOU2 loaded heavily on a factor completely unaligned with its intended theoretical group. Furthermore, for the Technology Exposure construct, item TE3 cross-loaded between Factor 4 (0.449) and Factor 6 (0.549), suggesting that respondents experienced conceptual confusion

between their prior technology exposure and the system's actual ease of use or utility. Similarly, within the dependent variable scale, the first item measuring Intention to Use (ITU1) exhibited significant cross-loadings of 0.441, 0.530, and 0.487, a condition that would inherently distort the final regression model if left unaddressed.

To rectify these cross-loadings and correct the weak item placements of these specific indicators, a secondary factor analysis was conducted. In this iteration, the problematic items exhibiting high cross-loadings or poor primary factor alignment specifically PEOU2, TE3, and ITU1 were systematically removed from the instrument. The cleaned, revised factor structures and their optimized item loadings are presented comprehensively in **Table 4**.

Table 4 Rotated Component Matrix (Revised)

Construct	Item	Factor Loading
Perceived Usefulness (PU)	PU1	0.790
	PU2	0.809
	PU3	0.685
Perceived Ease of Use (PEOU)	PEOU1	0.739
	PEOU3	0.545
Perceived Enjoyment (PE)	PE1	0.841
	PE2	0.856
	PE3	0.700
Technology Anxiety (TA)	TA1	0.943
	TA2	0.899
	TA3	0.909
Technology Exposure (TE)	TE1	0.839
	TE2	0.774
Intention to Use Self-checkout Technology (ITU)	ITU2	0.738
	ITU3	0.810

After removing PEOU2, TE3, and ITU1, the new factor analysis confirmed that all constructs are statistically distinct and have high factor loadings exceeding 0.5, ensuring that the data is valid for subsequent regression and moderation testing.

Reliability Test

Table 5 Cronbach's Alpha

Variable	Number of Items	Cronbach's Alpha
Perceived Usefulness	3	0.873
Perceived Ease of Use	2	0.777
Perceived Enjoyment	3	0.915
Technology Anxiety	3	0.925
Technology Exposure	2	0.853
Intention to Use Self-checkout Technology	2	0.871

Based on the result of Cronbach's Alpha as shown in **Table 5**, all variables show high reliability, which indicate the data were both valid and reliable, with Cronbach's Alpha values ranging from 0.777 (Perceived Ease of Use) to 0.925 (Technology Anxiety), all well above the 0.7 threshold.

Normality Test

Table 6 Skewness and Kurtosis

Variable	N	Skewness		Kurtosis	
		Statistic	Std. Error	Statistic	Std. Error
Perceived Usefulness	102	-0.863	0.239	-0.190	0.474
Perceived Ease of Use	102	-0.561	0.239	-0.476	0.474
Perceived Enjoyment	102	-0.646	0.239	-0.821	0.474
Technology Anxiety	102	0.331	0.239	-1.133	0.474
Technology Exposure	102	-0.863	0.239	-0.190	0.474
Intention to Use Self-checkout Technology	102	-0.561	0.239	-0.476	0.474

Based on **Table 6**, the normality test results show that all variables exhibited skewness and kurtosis values within the acceptable range of -2 to +2. This indicates that the data were approximately normally distributed. Consequently, the

dataset was deemed suitable for subsequent parametric analyses, including multiple regression and moderation testing.

Descriptive Analysis

Table 7 Mean and Standard Deviation

Variable	Mean	Standard Deviation	Level
Perceived Usefulness	4.2614	0.69356	High
Perceived Ease of Use	4.0588	0.80313	High
Perceived Enjoyment	4.0098	0.90647	High
Technology Anxiety	2.7647	1.24686	Moderate
Technology Exposure	4.0490	0.79761	High
Intention to Use Self-checkout Technology	4.2696	0.71984	High

Mean value (Low = 1.00 - 2.33; Moderate = 2.34 - 3.67; High = 3.68 - 5.00)

Descriptive analysis results shown in **Table 7** revealed generally positive perceptions of self-checkout technology among respondents. High mean scores were observed for perceived usefulness ($M = 4.2614$), perceived ease of use ($M = 4.0588$), perceived enjoyment ($M = 4.0098$), technology exposure ($M = 4.0490$), and intention to use self-checkout technology ($M = 4.2696$), indicating strong agreement with these constructs. Technology anxiety recorded a moderate mean score ($M = 2.7647$), suggesting that respondents experienced some level of discomfort, though anxiety was not dominant. The standard deviation values, ranging from 0.69356 to 1.24686, indicate moderate variability in responses, particularly for technology anxiety, reflecting individual differences in comfort levels with self-checkout technology.

Moderation Analysis (PROCESS Macro)

Table 8 Interaction Effects

Variable	Interaction Effect (B)	p-value	R-square Change
Perceived Usefulness	0.115	0.282	0.007
Perceived Ease of Use	0.063	0.468	0.003
Perceived Enjoyment	-0.481	0.070	0.025
Technology Anxiety	-0.013	0.842	0.000
Technology Exposure	0.158	0.067	0.017
Intention to Use Self-checkout Technology	0.115	0.282	0.007

Moderation analysis using Hayes' Process Macro examined whether generational cohort moderated the relationships between acceptance factors and intention to use self-checkout technology. The interaction effects shown in **Table 8** for perceived usefulness ($B = 0.115$, $p = 0.282$), perceived ease of use ($B = 0.063$, $p = 0.468$), and technology anxiety ($B = -0.013$, $p = 0.842$) were not statistically significant, indicating no moderation effect. However, marginal interaction effects were observed for perceived enjoyment ($B = -0.481$, $p = 0.070$, $\Delta R^2 = 0.025$) and technology exposure ($B = 0.158$, $p = 0.067$, $\Delta R^2 = 0.017$). These values suggest that while generational cohort does not strongly moderate the relationships, enjoyment and exposure exhibit slight generational differences in influencing intention to use self-checkout technology.

Multicollinearity Test

Table 9 Tolerance and VIF Value

Variable	Tolerance Value	VIF Value
Perceived Usefulness	0.384	2.607
Perceived Ease of Use	0.312	3.203
Perceived Enjoyment	0.381	2.624
Technology Anxiety	0.777	1.287
Technology Exposure	0.525	1.905

As shown in **Table 9**, it confirms that multicollinearity is not a concern among the variables. All tolerance values ranged from 0.312 to 0.777, exceeding the minimum threshold of 0.10, while VIF values ranged from 1.287 to 3.203, well below the critical value of 10. These results indicate that multicollinearity was not present in the regression model.

and that the independent variables were sufficiently distinct from one another, allowing reliable interpretation of regression coefficients.

Hypothesis Testing (Multiple Regression Analysis)

Table 10 Results of Direct Hypothesis Testing

Hypothesis	Beta	Sig.	Result
H1: Perceived usefulness positively influences the intention to use self-checkout technology.	0.042	0.699	Not Supported
H2: Perceived ease of use positively influences the intention to use self-checkout technology.	0.118	0.256	Not Supported
H3: Perceived enjoyment positively influences the intention to use self-checkout technology.	0.340	< 0.001	Supported
H4: Technology anxiety negatively influences the intention to use self-checkout technology.	-0.10	0.020	Supported
H5: Technology exposure positively influences the intention to use self-checkout technology.	0.205	0.012	Supported

The multiple regression analysis results as in **Table 10** reveals that Perceived Enjoyment is the primary driver of self-checkout technology adoption (beta = 0.340, $p < 0.001$), while Technology Anxiety acts as a significant barrier (beta = -0.100, $p = 0.020$). Interestingly, traditional adoption factors like Perceived Usefulness and Perceived Ease of Use failed to reach statistical significance in this model, suggesting that for this specific technology, user intent is motivated more by the intrinsic experience and emotional comfort than by functional utility or simplicity.

Table 11 Results of Moderation Hypothesis Testing

Hypothesis	Result
H6: The relationships between perceived usefulness and the intention to use self-checkout technology are moderated by the generational cohorts (Gen-Z, Millennials, and Gen-X).	Not Supported
H7: The relationships between perceived ease of use and the intention to use self-checkout technology are moderated by the generational cohorts (Gen-Z, Millennials, and Gen-X).	Not Supported
H8: The relationships between perceived enjoyment and the intention to use self-checkout technology are moderated by the generational cohorts (Gen-Z, Millennials, and Gen-X).	Partially Supported
H9: The relationships between technology anxiety and the intention to use self-checkout technology are moderated by the generational cohorts (Gen-Z, Millennials, and Gen-X).	Not Supported
H10: The relationships between technology exposure and the intention to use self-checkout technology are moderated by the generational cohorts (Gen-Z, Millennials, and Gen-X).	Marginally Supported

The moderation analysis examined whether generational cohort (Gen-Z, Millennials, and Gen-X) altered the relationships between acceptance factors and intention to use self-checkout technology. The results as in **Table 11** indicate that most moderation hypotheses were not supported, suggesting that generational differences do not substantially change how these factors influence intention to use self-checkout technology.

H6 and H7 were not supported because the interaction effects between perceived usefulness and perceived ease of use with generational cohort were not statistically significant. This indicates that the effects of usefulness and ease of use on intention to use self-checkout technology are consistent across all generations. As self-checkout technology has become widely adopted, these utilitarian factors are perceived as basic requirements rather than generation-specific motivators.

H8 was partially supported because the interaction between perceived enjoyment and generational cohort approached statistical significance. While the effect did not meet the conventional significance threshold, the interaction pattern suggests that enjoyment plays a relatively stronger role for younger users compared to older generations. This indicates a trend rather than a definitive moderation effect.

H9 was not supported as generational cohort did not significantly moderate the relationship between technology anxiety and intention to use self-checkout technology. This suggests that technology anxiety reduces intention to use self-checkout technology in a similar manner across all age groups, indicating that anxiety functions as a universal barrier rather than a generation-dependent factor.

H10 was marginally supported because the interaction between technology exposure and generational cohort was close to statistical significance. The results suggest that increased technology exposure has a slightly stronger positive influence on intention to use self-checkout technology among older consumers, while younger users already possess high exposure levels. However, the effect was not strong enough to confirm full moderation.

Table 12 Model Summary

Model	R	R-square	Adjusted R-square	Std. Error of the Estimate
1	0.836	0.699	0.683	0.38840

Table 12 presents the model summary of the regression analysis. The R value of 0.836 indicates a strong overall correlation between the independent variables and intention to use self-checkout technology. The R² value of 0.699 suggests that approximately 69.9% of the variance in intention to use self-checkout technology can be explained by the five predictors included in the model.

The adjusted R² value of 0.683 remains high after adjusting for the number of predictors, indicating that the model has strong explanatory power and is not inflated by unnecessary variables. The standard error of the estimate (0.38840) is relatively low, suggesting that the predicted values of intention to use self-checkout technology are close to the observed values. Overall, these results indicate that the regression model is robust and suitable for hypothesis testing.

Discussions

Addressing Research Objective 1

The results demonstrate that perceived enjoyment is the strongest positive predictor of intention to use self-checkout technology. This suggests that consumers are more inclined to adopt self-checkout systems when the checkout process is engaging and provides a pleasant user experience. In voluntary retail settings where customers can choose between automated and cashier-assisted checkout, enjoyment appears to play a critical role in motivating continued use. This finding supports the growing body of literature that emphasizes the importance of hedonic value in consumer-facing technologies, particularly when functional requirements such as usefulness and ease of use are already expected.

Technology exposure also emerged as a significant positive factor influencing intention to use self-checkout technology. Consumers who are more familiar with digital technologies tend to feel more confident and comfortable interacting with automated systems, which increases their willingness to adopt self-checkout options. This highlights the role of familiarity and habitual technology use in reducing uncertainty and encouraging adoption, especially in retail environments where efficiency and speed are valued.

In contrast, technology anxiety was found to negatively influence intention to use self-checkout technology. Although respondents generally reported moderate levels of anxiety, its significant effect indicates that psychological discomfort remains a barrier for certain users. Concerns about making mistakes, system errors, or feeling embarrassed during the checkout process can discourage consumers from using self-checkout systems, even when the technology is widely available.

Interestingly, perceived usefulness and perceived ease of use did not significantly influence intention to use self-checkout technology. While these factors recorded high mean values in the descriptive analysis, their lack of significance suggests that they are perceived as basic requirements rather than distinguishing motivators. As self-checkout technology has become increasingly common in retail settings, consumers may assume that such systems are inherently useful and easy to operate, reducing their impact on adoption decisions.

Addressing Research Objective 2

The moderation analysis indicates that generational cohort does not significantly alter most of the relationships between acceptance factors and intention to use self-checkout technology. This suggests that the underlying mechanisms influencing adoption are largely consistent across Gen-Z, Millennials, and Gen-X. The widespread exposure to digital technologies across age groups may explain this convergence in consumer behaviour.

However, marginal moderation effects were observed for perceived enjoyment and technology exposure. These findings suggest subtle generational differences rather than strong moderating influences. Perceived enjoyment appears to play a slightly more prominent role among younger consumers, who may place greater value on engaging and seamless digital interactions. Conversely, technology exposure showed a marginally stronger effect among older

consumers, indicating that increased familiarity may be particularly important in encouraging adoption within this group.

The absence of significant moderation for technology anxiety suggests that discomfort with technology functions as a universal barrier, affecting consumers across all age groups in a similar manner. This finding implies that efforts to reduce anxiety through improved system design, clearer instructions, or staff assistance could benefit users regardless of generational cohort.

Implications of the Findings

Overall, the discussion highlights that self-checkout technology adoption in the Malaysian retail context is driven more by experiential quality, familiarity, and psychological comfort than by traditional measures of usefulness or ease of use. These findings support the extension of the Technology Acceptance Model to include experiential and psychological factors when examining mature, consumer-oriented technologies. For retailers, the results suggest that strategies aimed at enhancing user experience, increasing consumer familiarity, and reducing anxiety may be more effective than focusing solely on functional improvements. Designing intuitive and engaging interfaces, providing user guidance, and offering initial support during checkout could encourage broader adoption across diverse consumer segments.

Conclusion

This study examined the determinants of consumers' intention to use self-checkout technology among Gen-Z, Millennials, and Gen-X within the Malaysian retail context by extending the Technology Acceptance Model with experiential and psychological factors. The findings demonstrate that adoption of self-checkout technology is influenced more strongly by users' experiences, familiarity, and emotional comfort than by traditional functional evaluations.

Perceived enjoyment emerged as the most influential positive factor, indicating that consumers are more likely to adopt self-checkout systems when the checkout process is engaging and satisfying. Technology exposure also played a significant role, suggesting that repeated interaction with digital technologies enhances confidence and readiness to use automated systems. In contrast, technology anxiety negatively affected intention to use self-checkout technology, highlighting that apprehension and fear of making mistakes remain relevant barriers despite the increasing prevalence of self-service technologies.

Interestingly, perceived usefulness and perceived ease of use were not significant predictors of intention. This suggests that in mature retail environments, these attributes are viewed as basic expectations rather than decisive adoption factors. Additionally, the analysis revealed limited moderating effects of generational cohort, indicating that acceptance mechanisms are largely consistent across age groups, with only minor variations related to enjoyment and technology exposure.

Overall, the study underscores the importance of moving beyond purely utilitarian perspectives when examining consumer-facing technologies. By emphasizing experiential quality, familiarity, and psychological comfort, retailers can more effectively encourage sustained use of self-checkout technology across diverse consumer segments.

Limitations and Future Studies

While this study provides valuable insights into self-checkout technology acceptance, several limitations should be considered when interpreting the findings. First, the sample size, although sufficient for the statistical analyses employed, limits the generalizability of the results. The use of non-probability sampling and the focus on respondents with prior experience using self-checkout technology may not fully represent the broader population of retail consumers, particularly those who actively avoid self-service systems.

Second, the study was conducted within an urban and suburban Malaysian retail context, where exposure to digital technologies is relatively high. Consumer attitudes toward self-checkout technology may differ in rural areas or regions

with lower levels of technological infrastructure and familiarity. Therefore, caution should be exercised when extending the findings to different geographical or socio-economic settings.

Third, the cross-sectional research design captures perceptions and intentions at a single point in time. Technology acceptance is a dynamic process, and consumers' attitudes may evolve as they gain more experience with self-checkout systems or as system features improve. As such, the findings do not reflect changes in behaviour over time.

Future research could address these limitations by employing larger and more diverse samples to enhance representativeness. Longitudinal research designs would be particularly valuable in examining how consumers' confidence, attitudes, and usage intentions develop with continued exposure to self-checkout technology. In addition, future studies may explore other moderating variables such as education level, income, digital literacy, or retail format to provide a more nuanced understanding of technology acceptance. Qualitative approaches, including interviews or focus groups, could also complement quantitative findings by offering deeper insights into consumers' experiences and emotional responses toward self-checkout technology.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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