

The Relationship between Security and Customer Satisfaction in Digital Wallet Services

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Abstract

Digital wallets have become an essential part of how we make payments today, proving themselves to be one of the most important technologies of the 21st century. In Malaysia, increasing internet penetration and the growing number of smartphone users have driven widespread adoption of digital wallets for transactions. However, as smart technology continues to evolve rapidly, user concerns over security risks have intensified. Safeguarding personal information is critical in the digital landscape, and the security measures implemented by third-party online payment providers play a significant role in shaping customer satisfaction. This research aims to evaluate the key dimensions of digital wallet security that are highly valued by users in Malaysia, assess the level of customer satisfaction, and examine the relationship between these factors within the context of digital wallet services in Malaysia. The study focuses on the population of 1.2 million Malaysian university students who have used digital wallet services. Based on the Krejcie and Morgan table, the appropriate sample size for this study is 384 respondents. A quantitative research approach was adopted, utilizing a Google Form questionnaire to collect data. A total of 263 responses were gathered from university students in Malaysia, yielding a response rate of 68.49%. The collected data was analysed using the Statistical Package for Social Sciences (SPSS), producing quantitative reports in the form of frequency, percentage, mean, and standard deviation. The findings confirmed that all hypotheses were accepted, indicating significant relationships between all variables and customer satisfaction. Notably, the authentication dimension exhibited the highest correlation coefficient at 0.775, underscoring its strong influence on customer satisfaction.

1. Introduction

The advancement of new technology has led to a significant rise in cashless transactions, particularly for financial purposes such as digital wallets (Muhtasim *et al.*, 2022). Digital wallets have emerged as an essential element of electronic payment systems, showcasing the transformative potential of 21st-century technology, offering a convenient and secure platform, digital wallets facilitate various financial activities, including shopping, bill

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payments, and money transfers (Uddin *et al.*, 2014). The growing reliance on electronic transactions in today's interconnected world highlights the significance of digital wallets as one of the most recognized and widely adopted payment solutions. In many countries, digital wallets have become a routine part of daily transactions, driving the global transition toward cashless societies and redefining interactions between consumers and businesses (Muhtasim *et al.*, 2022). E-wallets streamline payments and purchases by allowing seamless money transfers and transactions through phone numbers, business registrations, QR codes, or other identifiers, benefiting even recipients without traditional bank accounts (Samsudin & Kasiran, 2023). According to Statista research department, in 2022, the number of mobile wallet users in Malaysia amounted to more than 17 million users. The increasing reliance on digital payments has heightened the need for secure, transparent platforms as growing consumer adoption of smart technology amplifies concerns over security risks driven by rapid technological advancements. Intrusions like online fraud, hacked accounts, and other disruptions to the digital economy led to user disengagement (Karim *et al.*, 2022). The operating system, which serves as the foundation for e-wallet applications, presents potential vulnerabilities (Samsudin & Kasiran, 2023). Ultimately, the security measures implemented by third-party online payment providers play a crucial role in shaping customer satisfaction (Soodan & Rana, 2020). Customer satisfaction can be defined as a metric used to evaluate the extent to which customers are content with a company's products, services, and overall performance. It is commonly conceptualized as a feeling of fulfillment or pleasure experienced by individuals following the use of a service or system. From an academic perspective, customer satisfaction serves as a critical indicator of how effectively an organization meets or exceeds customer expectations. Measuring and analyzing this construct provides valuable insights into areas of success and potential improvement, ultimately contributing to enhanced service quality and customer retention (Septyanto *et al.*, 2023). Customer satisfaction information, including surveys and ratings, can help a company determine how to best improve or change its products and services where it applies to industrial firms, retail and wholesale businesses, government bodies, services companies, nonprofit organizations, and every subgroup within an organization (Sangeetha *et al.*, 2023). Therefore, companies must meet the needs and desires of customers so that they feel satisfied. Customer satisfaction can trigger service recommendations to others and provide benefits for the company (Tandenga *et al.*, 2018).

Bank Negara Malaysia (BNM) highlighted that the digitalization of financial services accelerated in 2020, driven by a growing shift toward online transactions. E-wallet usage experienced a significant rise, with transactions increasing by 131% to approximately 600 million that year (Mail, 2021). However, this surge has also created more opportunities for scammers to engage in fraudulent activities (CyberSecurity Malaysia, 2021). The Federation of Malaysian Consumers (Fomca) reported that scam tactics have become more sophisticated, receiving around 450 complaints and inquiries regarding fraud cases since January 2021 (CyberSecurity Malaysia, 2021). According to CyberSecurity Malaysia (CSM), 5,917 cybersecurity incidents were reported in the previous year, with 3,705 cases related to scams or fraud (Mok, 2024). CSM has urged organizations and internet users to implement safety measures to prevent data breaches, particularly concerning Personally Identifiable Information (PII), which can be extracted from compromised websites and openly traded on online forums (Mok, 2024).

As digital payment adoption grows, online financial fraud is becoming increasingly prevalent in Malaysia. Scammers have targeted the RM1 billion allocation under the eMadani initiative by deceiving e-wallet users into exchanging their digital credits for non-existent cash (Mahari, 2023). To counter these threats, e-wallet providers must strengthen their security measures to prevent misuse of their platforms (Mahari, 2023). In response to the rising number of security breaches affecting e-wallets and banking transactions, Touch 'n Go eWallet has implemented key security measures mandated by BNM to combat financial scams (Afandi, 2022). Additionally, Moorthy *et al.* (2020) found that 89% of Malaysians remain concerned about e-wallet security, making it a significant barrier to widespread adoption. Users fear potential criminal activities associated with digital transactions (Teo, Law & Koo, 2020) and are apprehensive about privacy risks, including data fraud and spam (Wolfenbarger & Gilly, 2003). Although e-wallets have gained popularity due to their convenience, a lack of awareness and security concerns continue to deter some users from fully embracing the technology (Marimuthu & Roseline, 2020). Security and privacy play a crucial role in shaping consumer behavior and satisfaction regarding digital payment services in Malaysia (Al-Okaily *et al.*, 2020).

Therefore, to achieve the research objectives the dimension of digital wallet security that are rated highly by the customer in Malaysia and the level of customer satisfaction towards digital wallet services are determined. Consequently, the relationship between security and customer satisfaction on digital wallet services in Malaysia is identified.

2. Literature Review

2.1 Theoretical Background

Few theories have been used to explain customer satisfaction including Expectancy-Disconfirmation Paradigm (EDP) Theory (Oliver, 1980), Value Percept Disparity Theory (Locke, 1967), Comparison Level Theory (Thibaut & Kelly, 1959) and The Equity Theory (Adams, 1963). The marketing and consumer behavior literature has traditionally suggested that customer satisfaction is a relative concept and is always judged in relation to a standard (Olander, 1977). Consequently, these theories have been used to explain customer satisfaction. In this study, the Expectancy-Disconfirmation Paradigm (EDP) Theory (Oliver, 1980) is chosen as this theory has highlighted as the most accepted model, suggesting satisfaction arises from the match or mismatch between expectations and actual product performance.

2.1.1 Expectancy-Disconfirmation Paradigm (EDP) Theory

Oliver (1977; 1980) introduced the Expectancy-Disconfirmation Paradigm (EDP) as a highly effective theoretical framework for evaluating customer satisfaction. According to this model, consumers make purchases based on pre-purchase expectations regarding the anticipated performance of a product or service. These expectations then serve as a benchmark for evaluating the product after the purchase. According to (Zhang *et al.*, 2021), it posits that citizens compare the performance of a service against their expectations of that service. Satisfaction occurs if the perceived performance meets or exceeds the expectations (Yüksel & Yüksel, 2008). Customers have expectations about how well a company will protect their data and privacy. A positive experience (meeting or exceeding expectations) could involve features like strong authentication, clear privacy policies, and prompt responses to security breaches. Conversely, a negative experience when service performance is not as good as what the customer expected, there is a negative disconfirmation between expectations and perceptions which causes dissatisfaction (Yüksel & Yüksel, 2008) where it could involve data leaks, weak password requirements, or a lack of transparency about data practices.

2.2 Digital Wallet

A digital wallet, commonly known as an electronic wallet, is an online payment method that has become a leading digital technology trend in Malaysia's consumer market through mobile device integration (Abdullah *et al.*, 2020). Digital wallet payments, also known as e-wallets, have emerged as one of the most prominent transaction methods today, offering ease, flexibility, and security in electronic transactions (Uddin, *et al.*, 2014). As a key component of electronic payment mobility, e-wallet applications allow users to conduct transactions seamlessly under their control, eliminating the need for physical cash (Hatamleh *et al.*, 2023). E-wallet applications have become the preferred choice for consumers today due to their convenience and efficient money management features (Samsudin & Kasiran, 2023). These digital payment systems, compatible with all mobile devices, enable users to transfer funds through online banking and conduct transactions using the balance stored in their digital wallets (Farid Shamsudin *et al.*, 2020). Many businesses in Malaysia, including those in retail, banking, and hospitality, have integrated mobile payment solutions such as Touch 'n Go eWallet, Boost, and GrabPay into their operations (Farid Shamsudin *et al.*, 2020).

According to Sabli (2021), e-wallets also allow users to incorporate additional digital functions, supporting a variety of activities that enhance social interactions, including entertainment, travel, and rewards collection. Moreover, Samsudin & Kasiran (2023) emphasized that these applications help users efficiently manage and coordinate their social engagements, offering a structured approach to both daily activities and leisure pursuits. The adoption of meal-ordering services also gained momentum, especially during the COVID-19 pandemic, aligning with the growing reliance on e-wallets (Ojo *et al.*, 2022).

Despite the advantages of mobile payment systems, the widespread use of digital wallets in Malaysia remains constrained by concerns over trust and security, particularly regarding online fraud and scams. Due to varying user experiences and security perceptions, companies often invest in promotional campaigns to enhance customer confidence and satisfaction (Famiyeh *et al.*, 2018).

2.3 Customer Satisfaction

Customer satisfaction is basically the judgment a consumer makes in relation to his/her sense of fulfilment related to his/her choices about the purchase and use of specific products and services (Guido, 2015). According to Al-Jazzazi & Sultan (2017), customer satisfaction serves as a measure of an organization's performance based on how well it meets consumer needs. Customers play a crucial role as key stakeholders in a company, given their direct influence on transactions as end users (Baharin & Nayan, 2020). Businesses generate profits through product and service sales that align with customer demands, while customer retention fosters long-term loyalty (Ilyas & Nayan, 2020). Nariyari (2022) further highlights that customer satisfaction benefits companies in two primary ways: word-of-mouth promotion by satisfied customers and enhanced customer loyalty. Additionally, Hill *et al.* (2007) suggest that customer satisfaction can predict future consumer behavior, making it a key determinant of a

company's success (Nariyari *et al.*, 2022). As a result, service providers must prioritize and sustain customer satisfaction.

Amin *et al.* (2015) found that while ease of technology use influences behavior, it is equally important to understand the level of gratification users experience. In the context of e-wallets, Bhattacharjee (2001) states that an initial positive experience with an e-wallet service fosters satisfaction, whereas a negative experience leads to dissatisfaction. If users are dissatisfied, they are likely to switch to alternative products (Havidz *et al.*, 2022). Ideally, organizations should focus on delivering high-quality products and services while creating value to strengthen customer relationships. Strong customer relationships, in turn, promote loyalty, ensuring business stability and sustainability in the marketplace (Hamzah *et al.*, 2017).

2.4 Security

Security is a crucial factor in financial transactions conducted through digital platforms. Consequently, concerns over security can become a major obstacle to the widespread adoption of e-wallets, as personal and financial data could be exposed and exploited for fraudulent purposes (Karim *et al.*, 2022). Kahar *et al.* (2018) emphasized that security is a key risk factor influencing customer decision-making when purchasing products or using digital services. Similarly, Sanayei *et al.* (2011) defined security as the safeguarding of transaction details and customer information from both internal and external threats. Based on these perspectives, security can be understood as a protective process designed to minimize consumer concerns regarding fraud and misuse (Visakha & Keni, 2022). Since e-payment systems require robust privacy and security measures, consumers may hesitate to adopt mobile-based financial technology unless it is deemed trustworthy (Gitau & Nzuki, 2014).

Several researchers have noted that essential e-wallet functions, such as authentication, modification, and verification of transactions, primarily focus on technical security measures, including privacy protection and data integrity (Linck *et al.*, 2006). Abrazhevich (2004) reinforced this viewpoint, identifying security as a fundamental aspect of e-wallet system research. The effectiveness of an e-wallet's security features depends significantly on the provider's motivation and technological development capabilities (Samsudin & Kasiran, 2023). According to Hatamleh *et al.* (2023), the reputation of an e-wallet brand plays a key role in consumer adoption, as users are influenced by the security features offered. Lim, Lee, and Kurnia (2007) also recognized that consumer concerns over security impact their willingness to use e-payment systems. Furthermore, Marianus & Ali (2021) identified integrity, privacy, and authentication as key dimensions in assessing perceived security.

2.4.1 Integrity

Turban *et al.* (2010) stated that integrity ensures data remains accurate and unaltered. Systems with strong integrity are more effective at detecting and preventing unauthorized modifications, such as incorrect alterations, deletions, or additions (Hartono *et al.*, 2014). Integrity is closely linked to the credibility of information resources, requiring data to be complete and authentic to ensure it remains unchanged or undamaged during transactions or transmissions (Hassan *et al.*, 2020). The greater the assurance of data integrity provided by a company, the stronger the sense of security felt by consumers when engaging in transactions. This reassurance ensures that consumers trust the company not to modify their data unlawfully (Marianus & Ali, 2021).

2.4.2 Privacy

Biryukov & Tikhomirov (2019) define privacy in electronic payments, including mobile transactions, as a process where banks, mobile payment platforms, or other intermediaries do not have access to details about where customers are spending their money. Similarly, merchants or receiving entities should not be able to view a customer's bank or account details. The data collected from customers by digital payment services is referred to as privacy details, often including personal information used for registration and authentication purposes (Muhtasim *et al.*, 2022). According to Soodan *et al.* (2020), privacy and security are significant factors influencing e-wallet adoption. A lack of these protections discourages customers from making purchases unless their data is adequately safeguarded (Milberg, Smith & Bruke, 2000). Additionally, using e-wallets without robust security and privacy features can lead to unauthorized access to personal information, creating an opportunity for cybercriminals to exploit sensitive data (Kaur *et al.*, 2018).

2.4.3 Authentication

Authentication refers to the process of verifying a user's identity to ensure that transactions and activities are conducted by a legitimate and trustworthy individual (Muhtasim *et al.*, 2022). A common example of this is the One-Time Password (OTP) verification required for completing payment transactions (Muhtasim *et al.*, 2022). Authentication plays a crucial role in allowing users to enter their credentials, and access is granted only if the provided information matches the system's records; otherwise, entry is denied (Hassan *et al.*, 2020). This feature reassures customers that they are dealing with verified vendors, enhancing their sense of security. Companies

that implement authentication for every transaction can increase customers' perceived security, thereby boosting their confidence and willingness to use the company's website for transactions (Marianus & Ali, 2021).

2.5 The Relationship between Security and Customer Satisfaction

Few studies have shown that security and customer satisfaction are closely related. For example, a study by (Thi *et al.*, 2024) found that offering substantiated data on the significance of security perception could shaping customer satisfaction in e-commerce. Moreover, according to (Utomo & Yasirandi, 2024), the importance of robust security measures in enhancing user satisfaction, highlighting that users value the assurance that their financial transactions and personal data are secure. Security, encompassing aspects like safety, personal data protection, and transaction security, is a crucial factor for online customers. Improving security protocols on e-commerce platforms can lead to increased customer satisfaction (Thi *et al.*, 2024).

2.6 Hypothesis

The research hypotheses are formulated from the research questions: "What is the relationship between security and customer satisfaction on digital wallet services?". The variables that were applied in this research are integrity, privacy, and authentication. The fundamental basis for developing the research's hypothesis was the association between security and customer satisfaction. In experimental settings, researchers contrast two or more groups of research subjects to look at variations in the findings. Based on these, it was hypothesised that:

H1: There is a significant relationship between integrity and customer satisfaction on digital wallet services.

H2: There is a significant relationship between privacy and customer satisfaction on digital wallet services.

H3: There is a significant relationship between authentication and customer satisfaction on digital wallet services.

2.7 Conceptual Framework

The conceptual framework aims to show the independent and dependent variables in this study. In this research, the security dimensions that become independent variables are integrity, privacy and authentication, and the dependent variable is customer satisfaction.

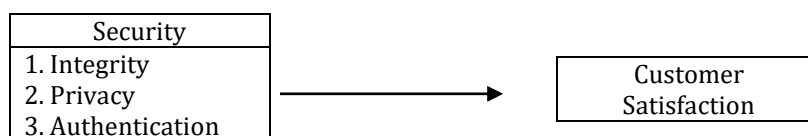


Fig. 1 Research framework

3. Research Methodology

3.1 Research Design

This research employs both a descriptive research design and a quantitative approach. Descriptive research provides a comprehensive and accurate representation of the subject under study, while quantitative research focuses on generating numerical data and analysing it statistically. The quantitative method is used to measure and assess variables, enabling researchers to draw conclusions efficiently. It is particularly advantageous due to its speed and ability to represent a larger population by selecting a sample group. Additionally, secondary data enhances the research process by providing high-quality information, allowing researchers to conduct more in-depth studies beyond merely reviewing literature or formulating research proposals.

This study will analyse the level dimension of digital wallet security that are rated highly by the customer in Malaysia as well as the level of customer satisfaction toward digital wallet services. This study also would analyse the relationship between security and customer satisfaction. The data collection for this research is through quantitative research and Malaysian university student have been targeted as the research respondent. A questionnaire has been established and distributed to respondent by Google Form. Malaysian university students were selected as respondent because they are familiar with digital wallet services as in 2023 the government has extended the e-Wallet aid to all eligible university students in the country.

3.2 Sampling Method

This research uses simple random sampling techniques to choose respondents. Through the use of sampling, this research can draw conclusions about a population without having to look at every single member of the population. Prior to beginning the research, it is important to identify the population and sampling in order to ensure that the goal can be met. The sampling technique must be identified since if it is not the right one, the

research's validity and reliability may suffer. It is simple to use and fairly portrays the general populace. Among all sampling strategies, this one is the most frequently applied.

This study has been conducted for university students in Malaysia. The population of the research consisted of students in higher education institutions under the MoHE with an estimated population of 1.2 million (Ministry of Higher Education Malaysia, 2022). According to David (2021), the population is the broader group of people to whom you want to apply your research findings. For this research, using the sampling schedule of Morgan (1970) as in Table 1, this study has set a total of 384 respondents to fill the questionnaire that will be distributed by social media using Google Form.

Table 1 Determining sample size method Krejcie and Morgan (1970)

<i>N</i>	<i>S</i>	<i>N</i>	<i>S</i>	<i>N</i>	<i>S</i>
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970

3.3 Research Instrument

This study employs a quantitative research method, utilising a questionnaire as the primary research instrument. A research instrument is a tool used to collect and compile data for analysis. The questionnaire, a key tool in quantitative research, is designed to gather structured data from respondents. It is divided into three sections: Section A focuses on respondents' background information, Section B explores customer satisfaction, and Section C examines security dimensions, including integrity, privacy, and authentication in relation to customer satisfaction. The questionnaire is adapted from the study by Muhtasim *et al.* (2022) and consists of multiple items measured using a Five-Point Likert Scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

3.4 Data Collection

3.5 Data Analysis

An analysis of data was conducted in order to identify the findings of the research and to establish whether this research will meet the research objectives. Data collected from the primary sources, which were questionnaires, will be analysed by using the descriptive analysis method and correlation analysis.

3.5.1 Descriptive Analysis

Descriptive analysis is used to determine percentages, average mean values, and frequencies. In this study, the researcher will apply descriptive analysis to understand how to derive population information from a sample. The statistical analysis for this research will be conducted using SPSS software. This approach will allow the researcher to clarify the basic results and data insights, such as percentages and mean values, for the study.

3.5.2 Correlation Analysis

Correlation analysis is used to assess the relationship between variables (Akhilesh, 2019). In this study, the researcher will employ correlation analysis to understand the degree of correspondence between the variables. Since the data was found to be non-normally distributed based on the normality test (Patrick *et al.*, 2018), the Spearman’s correlation coefficient method will be used to measure the strength of the relationship between the variables.

4. Data Analysis and Findings

This chapter addressed the research data and findings, which were collected by a questionnaire that respondents completed via a Google Form. To accomplish the goal of this study, the data analysis was carried out using the Statistical Package for the Social Sciences (SPSS). The data analysis was conducted, including reliability analysis, demographic analysis, descriptive analysis, and inferential analysis.

4.1 Response Rate

According to Krejcie & Morgan (1970), the sample size should be calculated based on the population number. For this study, at least 384 respondents were needed to complete the questionnaire. However, only 263 respondents participated in the online survey, as shown in Table 2, which was distributed through social media platforms such as WhatsApp, Telegram, and Instagram.

Table 2 Questionnaire response rate

Population	Sample Size	Questionnaire Distribute	Questionnaire Returned	Percentage
1000000	384	384	263	68.49%

4.2 Reliability Test

The result of data collection from the questionnaire that had been distributed to respondents determined the validity and reliability by using the Cronbach’s Alpha method and coefficient value as shown in Table 3.

Table 3 Reliability coefficient value

Cronbach’s Alpha (α)	Interpretation
$\alpha \geq 0.9$	Very Good
$\alpha \geq 0.8$	Good
$\alpha \geq 0.7$	Acceptable
$\alpha \geq 0.6$	Questioned
$\alpha \geq 0.5$	Weak
$\alpha < 0.5$	Unacceptable

4.2.1 Pilot Study

A pilot study is a preliminary or small-scale rehearsal to test the methods that are being used for research purposes (Enago Academy, 2022). It is an essential step in research processes in identifying design concerns and assessing the viability, practically, cost, time and resources of a project before conducting the research (Julia Simkus, 2023). To get excellent outcomes, a solid research study with a suitable experimental design and accurate performance is required (In Junyong, 2017). 30 questionnaires have been distributed to digital wallet users, and the result of the questionnaire was analysed using the Statistical Package for the Social Sciences (SPSS). Table 4 shows that the Cronbach’s Alpha values for integrity, privacy, and authentication are 0.755, 0.857 and 0.852. The value of Cronbach’s Alpha for customer satisfaction is 0.907. According to Taber (2018) if the value of Cronbach’s Alpha is greater than 0.7, the questionnaire’s reliability level is excellent. Since the results show that variables are reliable, the research can be conducted.

Table 4 Reliability test for pilot study

No	Variables	Number of items	Cronbach’s Alpha (α)
1.	Integrity	4	0.755
2.	Privacy	4	0.857
3.	Authentication	4	0.852

4.	Customer Satisfaction	4	0.907
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4.2.2 Actual Study

For this study, 263 respondents from digital wallet users have been chosen to get their responses. Based on Table 5, Cronbach's Alpha values for integrity, privacy and authentication are 0.817, 0.871 and 0.862. The value of Cronbach's Alpha for customer satisfaction is 0.824. The research instruments used are reliable since the result shows the reliability level of the questionnaire is greater than 0.7.

Table 5 Reliability test for the actual study

No	Variables	Number of items	Cronbach's Alpha (α)
1.	Integrity	4	0.817
2.	Privacy	4	0.871
3.	Authentication	4	0.862
4.	Customer Satisfaction	4	0.824

4.3 Descriptive Analysis (Demographic)

Table 6 presents the questions in Section A, which focus on the demographic information of the respondents. These questions cover aspects such as gender, race, age, education level, the use of digital wallets for payments, and the type of digital wallet most frequently used. The findings indicate that the items studied were highly relevant, and the data collected for the study demonstrated strong reliability and validity. The questions used were appropriate for this research.

Table 6 Summary of demographic analysis

Demographic	Item	Frequency (N)	Percentage (%)
Gender	Male	105	39.9
	Female	158	60.1
Race	Malay	152	57.8
	Chinese	64	24.3
	Indian	39	14.8
	Others	8	3.0
Age	18-20 years old	71	27.0
	21-22 years old	74	28.1
	23-24 years old	98	37.3
	25 years old and above	20	7.6
Education Level	Diploma	70	26.6
	Degree	169	64.3
	Master	18	6.8
	PhD	6	2.3
Use digital wallet	Yes	250	95.1
	No	13	4.9
Type of digital wallet use most frequently	Touch and Go e-wallet	131	49.8
	Grab pay	18	6.8
	Apple pay	34	12.9
	Shopee pay	49	18.6
	Boost	9	3.4
	MAE	17	6.5
	Samsung pay	5	1.9

4.4 Descriptive Analysis

Descriptive analysis is conducted to evaluate the data and provide the mean and standard deviation for all variables, such as integrity, privacy, authentication, and customer satisfaction. This method is effective for

distinguishing the components of the mean distribution using the Likert Scale to assess the extent of both independent and dependent variables. Table 7 illustrates the level of measurement for the central tendency of each question item in the questionnaire.

Table 7 *Level of measurement*

Average Mean Score	Level
1.00 – 2.33	Low
2.34 – 3.67	Medium
3.68 – 5.00	High

4.4.1 Integrity

Table 8 shows the value of mean, standard deviation, and level of variables of each question for the Integrity variable. The level of integrity towards customer satisfaction is high, with an average of 4.40.

Table 8 *Mean and standard deviation analysis for integrity*

No	Item Integrity	Mean (M)	Std. Deviation (SD)	Level
1	My digital wallet accurately sends my transaction information	4.48	0.635	High
2	My digital wallet does not alter my transaction details	4.25	0.764	High
3	My digital wallet accurately records my transaction information.	4.46	0.658	High
4	I have never encountered inconsistencies in my transaction history or balance while using a digital wallet	4.42	0.693	High
Total Average		4.40	0.554	High

4.4.2 Privacy

Table 9 shows the value of mean, standard deviation, and the level of variables of each question for the Privacy variable. The level of privacy towards customer satisfaction is high, with an average of 4.32.

Table 9 *Mean and standard deviation analysis for privacy*

No	Item Privacy	Mean (M)	Std. Deviation (SD)	Level
1	My digital wallet minimises the security risk for the confidential information obtained.	4.29	0.653	High
2	My digital wallet safeguards my data, ensuring it is only shared with my consent.	4.33	0.700	High
3	My digital wallet securely protects my confidential information.	4.33	0.677	High
4	I believe that digital wallet providers are transparent about how it collects and uses my personal information.	4.32	0.708	High
Total Average		4.32	0.581	High

4.4.3 Authentication

Table 10 shows the value of mean, standard deviation, and level of variables of each question for the Authentication variable. The level of authentication towards customer satisfaction is high with an average mean of 4.50.

Table 10 *Mean and standard deviation analysis for authentication*

No	Item Authentication	Mean (M)	Std. Deviation (SD)	Level
1	User authentication enhances the security of digital wallets and reduce the risk of fraud.	4.49	0.641	High
2	User authentication guarantees that the authorized cardholder controls digital wallet transactions.	4.61	0.547	High

3	User authentication serves as an additional layer of protection for digital wallets.	4.51	0.623	High
4	I never experienced any issues with the authentication process when accessing my digital wallet.	4.39	0.701	High
Total Average		4.50	0.530	High

4.4.4 Customer Satisfaction

Table 11 shows the value of mean, standard deviation, and level of variables of each question for the Customer Satisfaction variable. The level of customer satisfaction is high, with an average of 4.55.

Table 11 Mean and standard deviation analysis for customer satisfaction

No	Item Customer Satisfaction	Mean (M)	Std. Deviation (SD)	Level
1	I am satisfied with my decision to use this digital wallet service.	4.58	0.612	High
2	I am very pleased with my experience of using digital wallet service.	4.42	0.677	High
3	I plan to continue using digital wallet services in the future.	4.57	0.631	High
4	Overall, digital wallet services have significantly streamlined my day-to-day activities.	4.62	0.592	High
Total Average		4.55	0.508	High

4.4.5 Analysis on Security towards Customer Satisfaction

Based on Table 12, the variable that had the highest mean score is a dependent variable which is Customer Satisfaction with total average value (M= 4.55). The variable that had the lowest mean score is Privacy with total average value (M= 4.32).

Table 12 Analysis on security towards customer satisfaction

Item	Average Mean Score	Level
Integrity	4.40	High
Privacy	4.32	High
Authentication	4.50	High
Customer Satisfaction	4.55	High

4.5 Normality Test

According to Ghasemi (2012), a normality test is conducted to assess whether the study population follows a normal distribution. If the data is normally distributed, a parametric test, such as the Pearson correlation test, is applied. However, if the data is not normally distributed, a non-parametric test, such as the Spearman correlation test, is used. Additionally, to assess data normality, researchers utilize either the Kolmogorov-Smirnov or Shapiro-Wilk test.

Table 13 presents the results of the normality test using both the Kolmogorov-Smirnov and Shapiro-Wilk tests. The analysis involved 263 respondents, and Kolmogorov-Smirnov test values were considered. The findings indicate no significant normality, as all variables had p-values less than 0.001. As a result, the data is not normally distributed and is considered non-parametric. To examine the relationship between security and customer satisfaction and achieve the study's objectives, the Spearman correlation test was applied.

Table 13 Normality test

Variables	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Integrity	0.192	263	<0.001	0.863	263	<0.001
Privacy	0.209	263	<0.001	0.877	263	<0.001
Authentication	0.264	263	<0.001	0.799	263	<0.001
Customer satisfaction	0.234	263	<0.001	0.813	263	<0.001

a. Lilliefors Significance Correction

4.6 Correlation Analysis

Correlation analysis is used to determine the strength of the relationship between two variables. There are two types of correlation coefficients, Pearson and Spearman, used to test the linear relationship between independent and dependent variables (Aggarwal & Ranganathan, 2016). In this study, Spearman's correlation was used because the data is not normally distributed. Spearman's correlation is a nonparametric alternative to Pearson's correlation and is applicable when there is a monotonic relationship. In a monotonic relationship, as one variable increases, the other variable tends to either increase or decrease (Jim Frost, 2023).

4.6.1 The relationship between Integrity (I) and Customer Satisfaction (CS)

Table 14 shows the result of the relationship between integrity and customer satisfaction by using Spearman's correlation coefficient. The result indicates the value of Spearman's rho correlation is 0.684 with a significant value $p < 0.001$. This shows that there is a positive and moderate relationship between integrity and customer satisfaction. H1: There is a significant relationship between integrity and customer satisfaction in digital wallet service.

Table 14 Spearman's Correlation between integrity and customer satisfaction

		Customer Satisfaction
Integrity	Correlation Coefficient	0.684**
	Sig. (2-tailed)	<0.001
	N	263

4.6.2 The relationship between Privacy (P) and Customer Satisfaction (CS)

Table 15 shows the result on the relationship between privacy and customer satisfaction by using Spearman's correlation coefficient. The result indicates the value of Spearman's rho correlation is 0.605 with a significant value $p < 0.001$. This shows that there is a positive and moderate relationship between privacy and customer satisfaction. H2: There is a significant relationship between privacy and customer satisfaction in digital wallet services.

Table 15 Spearman's correlation between privacy and customer satisfaction

		Customer Satisfaction
Privacy	Correlation Coefficient	0.605**
	Sig. (2-tailed)	<0.001
	N	263

4.6.3 The relationship between Authentication (A) and Customer Satisfaction (CS)

Table 16 shows the result on the relationship between authentication and customer satisfaction on digital wallets services by using Spearman's correlation coefficient. The result indicates the value of Spearman's rho correlation is 0.775 with significant value $p < 0.001$. This shows that there is a positive and high relationship between authentication and customer satisfaction on digital wallet services. H3= There is a significant relationship between authentication and customer satisfaction in digital wallet services.

Table 16 Spearman's Correlation between authentication and customer satisfaction

		Customer Satisfaction
Authentication	Correlation Coefficient	0.775**
	Sig. (2-tailed)	<0.001
	N	263

5. Conclusion

Overall, the research objectives for this study were successfully achieved. The few sections will discuss the objectives of this study that has been carried out to identify the level of security influencing customer satisfaction in digital wallet services, the level of customer satisfaction towards digital wallet services and the relationship between security and customer satisfaction on digital wallet services.

The result shows the level of the average mean score for each variable. Based on the three variables, it shows that all variables, which are integrity, privacy and authentication, are at a high level with the total average of 4.40,

4.32 and 4.50. The results of the data analysis collected significantly confirm the hypotheses that have been set earlier, which state that there is a significant positive relationship between integrity, privacy and authentication with customer satisfaction. Consistent with previous studies, authentication with the highest score highlights the importance of secure login protocols, which have become standard practices in many digital wallet platforms that significantly impact customer satisfaction (Muhtasim *et al.*, 2022). Integrity and privacy, which also demonstrate the reliability of digital wallets in ensuring that transaction data remains unaltered and transparent, are key factors in their decision to adopt and continue using digital wallet services (Muhtasim *et al.*, 2022).

The findings indicate that the overall level of customer satisfaction with digital wallet services is high. Specifically, the results show that integrity, privacy, and authentication are key factors that significantly influence customer satisfaction. Most respondents agreed that digital wallet services have greatly simplified their daily activities. Overall, the feedback from respondents was very positive, leading to the conclusion that customer satisfaction with digital wallet services is at a high level.

The results also reveal that all variables have a positive and significant relationship with customer satisfaction in digital wallet services. All hypotheses were supported, with two showing a moderate correlation: a significant relationship between integrity and customer satisfaction, and a significant relationship between privacy and customer satisfaction. The hypothesis regarding the significant relationship between authentication and customer satisfaction demonstrated a high level of correlation.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** Nurelyana Amin, Siti Aisyah Salim; **data collection:** Nurelyana Amin; **analysis and interpretation of results:** Nurelyana Amin; **draft manuscript preparation:** Nurelyana Amin, Siti Aisyah Salim. All authors reviewed the results and approved the final version of the manuscript.

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