

Antecedents of User Satisfaction and Continuance Usage of Mobile Health Applications: A Study on MySejahtera Apps in Malaysia

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Abstract: *Given the focus on the use of mobile health applications (m-health apps) during the COVID-19 pandemic, the goal of this study is to determine the users' satisfaction and perceptions of m-health apps usage. The conceptual framework for this study was developed using the technology acceptance model, theory of reasoned action, and DeLone McLean model. This study had 215 participants, and the data were analysed using partial least square structural equation modelling. The results show that the highest user satisfaction was on the COVID-19 vaccination function while the lowest satisfaction was on the helpdesk function. Furthermore, the quality and performance of the m-health apps affected users' satisfaction and subsequently affected the continuance usage of the m-health apps. The findings will benefit the m-health apps developers in increasing the apps' functionality. As a result, the findings will help the government improve the function, information, performance, security, design, and quality of m-health apps.*

Keywords: Mobile Health Applications, MySejahtera, Quality, Performance, Design, Security, User Satisfaction, Continuance Usage

1. Introduction

2020 has brought immense challenges worldwide with the spread of coronavirus 19 (COVID-19) which led to the global pandemic. The hope of victorious combat against COVID-19 and the declaration of endemic by the end of 2021 did not turn into reality due to the existence of various variants such as Delta and Omicron. Continuous surveillance and proactive measures to limit the spread of the virus remain the priority. The world has learned a lot from two years of 'on and off' lockdown, not only in terms of high fatality rate but the global economy was also badly affected. Confronted with the COVID-19 catastrophe, an urgent response is required to manage prevention strategies, continuous social relationships, and economic activities. To reopen the economic sectors and ease the travelling restriction, various contact tracing apps have been used such as Corona-Warn-App in Germany, COCOA-COVID19 Contact App in Japan, NZ COVID Tracer in New Zealand, and TraceTogether in Singapore. In Malaysia, the mHealth app called MySejahtera was created during the first wave of COVID-19 to trace the infection, assess health risk status, monitor the quarantine of infected persons, and provide information on the nearest hospitals and clinics for COVID-19 screening. The MySejahtera's functionality has been expanded to include vaccination information. Despite all the

advancements, MySejahtera's role as a contact tracing platform was demolished on May 1, 2022.

Digital contact tracing apps are usually installed on the smartphone to trace the nearness between the devices that installed the same apps (Blasimme, Ferretti & Vayena, 2021). Various features have been embedded in the digital contact tracing systems and fitted into the mobile phone as mobile health (m-health) apps. Generally, m-health apps refer to health applications that are available on mobile devices (Vo et al., 2019). The apps complemented the use of wearables, tables and smartphone apps that gather health-related information (Suver & Kuwana, 2021). The usage of m-health apps during the pandemic becomes essential as they are accessible, acceptable, easily adopted, and can support social distancing efforts (Kondylakis, 2020).

Numerous efforts have been made to achieve users' satisfaction with the m-health apps. User satisfaction is important as the foundation for fulfilling the goal of the m-health apps. Despite the potential of m-health apps, their adoption has caused intense debates over several issues. For instance, Zamri and Mohideen (2021) highlighted that the users of m-health apps are exposed to three risks, which are privacy risks, security threats, and safety risks. Notwithstanding, there is also certain application error such as randomly assigning users to a Home Surveillance Order (HSO) and Person Under Surveillance (PUS) status. On another occasion, there is also dissatisfaction among users on the apps' performance such as lagging updates of MySejahtera when they were fully vaccinated.

After considering the issues linked to the m-health apps, particularly digital contact tracing in numerous countries including Malaysia (Akinbi, et al., 2021), it is worthwhile to investigate the users' satisfaction with the use of m-health apps. There is a lack of past studies on users' satisfaction with m-health apps. Most past studies on m-health apps were based on a systematic review that was not related to user satisfaction (Akinbi, et al., 2021; Kondylakis, 2020; Singh, Couch, 2020 & Yap; and Vo et al., 2019). Hence, the current study aims to examine the factors that lead to the users' satisfaction with the usage of m-health apps. Specifically, it examines whether the design, quality, performance, and security of the m-health apps influence the users' satisfaction. Furthermore, this study examines whether the users' satisfaction would contribute to the continuance usage of the m-health apps.

2. Theoretical Framework and Literature Review

Prior studies have applied technology acceptance theories to evaluate individuals' behavioural intentions to acknowledge a new technology and their satisfaction after using it. Specifically, technology acceptance model (TAM) (Davis, 1989), theory of reasoned action (TRA) (Fishbein & Ajzen, 1975), theory of planned behaviour (TPB) (Ajzen, 1991), and innovation diffusion theory (IDT) (Rojers, 2010). These theories dominated most studies (Yi & Liu, 2017; Hammouri et al., 2020) that examine the behavioural intentions of smartphone users.

To assess the users' satisfaction with mobile apps, most previous studies (Huang & Ren, 2020; Rafique et al., 2020) engaged the TAM theories or used one of its elements as the beginning of a framework. Most empirical research employed TRA (Moh'd Al-Dwairi et al., 2018; Otieno et al., 2016) and IDT (Chen et al., 2018; Kim et al., 2019) to investigate the mobile users' awareness of human characteristics. In aligning with the relationship between mobile apps and user satisfaction, this study employed TRA and TAM theories to investigate the individuals' satisfaction when using mobile apps as well as enhancing their awareness level.

Fishbein and Ajzen (1975) and Ajzen and Fishbein (1980) developed TRA that experimented with factors of intended behaviours. In line with TRA, an individual's behavioural intention will lead an individual to perform a specific behaviour (Davis, et al., 1989). Hence, this behavioural intention model can estimate and forecast an individual's actual behaviour status (Fishbein & Ajzen, 1975). The fundamental proposition of TRA is systematic thinking can control an individual to perform his or her specific behaviour.

TAM is a model for predicting users' acceptance of technology based on estimating the three core constructs, which are perceived usefulness, perceived ease of use, and intention to use (El-Wajeih et al., 2014). The founder of TAM used the model to describe users' computer usage behaviour. These variables influence trust in the perceived usefulness and perceived ease of use which affect the adoption and loyalty to m-commerce, and subsequently influence user satisfaction (Okazaki & Mendez, 2013; San-Martin & Lopez-Catalan, 2013).

However, the current study relied on the DeLone and McLean model to form the component of quality in the conceptual framework. The three components, namely information quality, system quality, and service quality were linked to user satisfaction.

2.1 Design

For user satisfaction, previous studies have examined the satisfaction of users towards technologies, such as mobile technologies (Finley et al., 2017; Wang et al., 2019), electronic government services (Al Athmay et al., 2016), and hospital information systems (Karimi et al., 2015). Most of the studies showed that elements such as perceived ease of use, perceived usefulness, quality of content, perceived value, quality of information, and quality of system may influence the satisfaction of users with technologies (Fernanda & Romes, 2020). A past study concluded that the design quality of applications strongly influenced the perceived ease of use (Lee et al., 2017). Most health applications are simplistic in design and only deliver information without focusing on the engagement between the provider and patients; this issue prevented their widespread and systematic usage by healthcare practitioners and patients (Zhang et al., 2014). A recent study by Kasim and Sofia Rozaini (2021) found that a simpler application is essential in influencing the use of MySejahtera application by users. Based on the above discussion, the following hypothesis was developed:

H₁. The design of MySejahtera has a positive relationship with user satisfaction.

2.2 Performance

The development of the internet network and services has resulted in the rise of the ability to download mobile applications that support users' needs. With the massive usage of mobile phone users and other devices that grow steadily with the improvement from 4G to 5G, mobile communication technologies can increase the use of mobile apps. Mobile users may gain a lot of experience via mobile applications that operate remotely and/or by device servers rather than wireless networks.

During the COVID-19 pandemic, mobile apps such as mobile health (mHealth) applications have become a significant tool for assisting public health, particularly during the rising of health awareness. mHealth services are services that improve personal healthcare by utilising mobile technology (Birkmeyer et al., 2021).

There are growing works of literature on mobile app performance. Mobile application users revealed that performance expectancy was one of the most powerful factors of mG-App

(mobile government app) acceptability (Sharma et al., 2018). The primary focus in the decision to adopt mG-App includes functional utilities. However, Chan et al. (2021) found no significant relationship between performance expectancy and the intention to use the mobile tracking application (MySejahtera) in Malaysia. They opined that Malaysian residents may feel that the MySejahtera app has fewer benefits as the use of the tracking app is mandatory. Venkatash et al. (2012) define performance expectancy as the extent of knowing how advantageous a technology is to users when executing their tasks. Users will increase their usage if they think that the performance of the mobile apps is good, thus leading to increasing their satisfaction.

Besides that, a study in China on m-commerce apps revealed that their performance positively affected user satisfaction (Ye & Liu, 2017). The authors stressed that mobile apps' performance may include (1) transaction process, (2) reliability of the content, (3) perceived system quality, (4) navigation convenience, (5) compatibility, (6) content quality, (7) content variety, and (8) design aesthetics. In addition, Tam et al. (2020) documented that a user of mobile apps would be more satisfied if the apps are useful for him/her. In their study on the attitudes of individuals concerning mobile apps, they found a positive relationship between performance expectancy with user satisfaction for the 304 samples via an online survey. Using structural equation modelling (SEM), the empirical results show that the performance of the mobile apps had increased the continuance usage of the mobile apps and user satisfaction. Thus, the following hypothesis was developed:

H₂. The performance of MySejahtera has a positive relationship with user satisfaction.

2.3 Security

The security of MySejahtera data is always an issue among users in Malaysia. The usage of MySejahtera for check-in at any premises is compulsory throughout the pandemic. The Malaysian government has implemented strict rules on security. The app provides the authorities with records of users' movements.

MySejahtera is owned and run by the Malaysian government, managed by the Ministry of Health, and assisted by the National Security Council (NSC), the Malaysian Administrative Modernisation and Management Planning Unit (MAMPU), and the Malaysian Communication and Multimedia Commission (MCMC) (Siti Seliah, Duryana, et al., 2021).

However, none of these four agencies manage the data. The involvement of different agencies has raised a concern about data security. The conflicting statement has raised concerns among the users. These issues highlighted the importance of protecting user privacy and data security after the pandemic (Cornish, 2020).

Despite the government's best approach to respond to the pandemic by tracking and tracing COVID-19 cases using MySejahtera, data security experts are concerned about the intrusion of government surveillance which affects the privacy right of citizens (Ainaa Aiman, 2020).

The question arises of which agencies are responsible for the ownership of the data. Too many conflicting statements from various agencies on data ownership have raised public concerns about their personal data privacy and security.

Despite not being subject to the Personal Data Protection Act (PDPA), the Department of Personal Data Protection (PDP) guarantees that action will be taken against any officer-in-charge if any misuse of data or data leak occurred. Any mishandling of the data will be charged

under the Official Secret Act 1972 [Act 88] under Section 8(1)(iv) and the Public Officers (Conduct and Discipline) Regulations 1993 (Qishin Tariq, 2020).

Fear of security vulnerabilities is one of the issues that can affect the advancement of mobile applications (Abu et al., 2017) and pose a significant risk to the security and privacy of users. Mahendra et al. (2017) defined perceived security as the confidence level that the application used to transmit the privacy data and transactions is secured and protected from any potential threats. Ramos et al. (2018) argued that perceived privacy and security for Brazilian users significantly affected their intentions to use mobile banking services. Meanwhile, Dhagarra et al. (2020) indicated that privacy influenced users' behaviour towards the use of technology in Indian healthcare services. Chan et al. (2021) found that perceived privacy credibility positively affected the intention to use MySejahtera. Hence, this study hypothesised the following:

H₃. The security of MySejahtera has a positive relationship with user satisfaction.

2.4 Quality

The quality in this study encompasses three components, which are service quality, information quality, and service quality inspired by DeLone McLean model. Service quality is an assessment of how well a service provider complies with the user's expectations (Singaraj et al., 2019). Service quality includes users' satisfaction with the quality of the service (Brady & Cronin, 2001). Information quality refers to the information gathered from a system that should be accurate, relevant, timeliness, and complete (Achmadi & Siregar, 2021). Generally, system quality is the desirable characteristic of an information system (DeLone & McLean, 1992).

A study conducted by Achmadi and Siregar (2021) on e-learning users found that service quality, system quality, and information quality significantly influenced users' satisfaction. In the same vein, a study on e-commerce by Siswanto and Triyonowati (2022) concluded that the three components of quality affected users' satisfaction. Based on a past study and theoretical model by DeLone McLean, the following hypothesis was developed:

H₄. The quality of MySejahtera has a positive relationship with user satisfaction.

2.5 User Satisfaction and Continuance Usage

User satisfaction is vital in assessing the experience of applying new technology or innovation. It signals the feeling of pleasure or disappointment with certain products based on individuals' expectations (Kotler, 1994). Previous studies have been conducted regarding the users' satisfaction with mobile apps used to support the self-management of hypertension (Alessa, et al., 2018), social networking (Hong, et al., 2017), health and fitness (Yin, et al., 2022), and education (Mussa, 2022).

This study conceptualised that user satisfaction is the fundamental component of continuance usage. It is common that users will decide whether to continue or discontinue using the products or technologies based on their satisfaction. This argument is supported by a study by Akdim et al. (2022) that the continuance usage of social mobile apps is derived from user satisfaction. Their study was performed based on utilitarian and hedonic approaches. A study by Al-Nabhani et al. (2022) discovered that the continuance usage of the mobile apps of multichannel retailers was due to consumer satisfaction. Furthermore, a study by Wu et al. (2022) demonstrated that user satisfaction was the factor that influenced the continuance usage of m-

health apps. Having considered the discussions of previous studies, the following hypothesis was developed:

H5. User satisfaction with MySejahtera will lead to continuance usage.

The proposed conceptual framework is presented in Figure 1. It conceptualises that the design, performance, security, and quality of the m-health app will affect user satisfaction and subsequently will affect continuance usage. The design of m-health app is represented by convenience, app aesthetics, perceived ease of use, and perceived usefulness. The performance of m-health app comprises content reliability, functionality, and performance expectancy. The security elements of the m-health app are safety, protection, and security. Finally, the quality of m-health app includes information, service, and system quality.

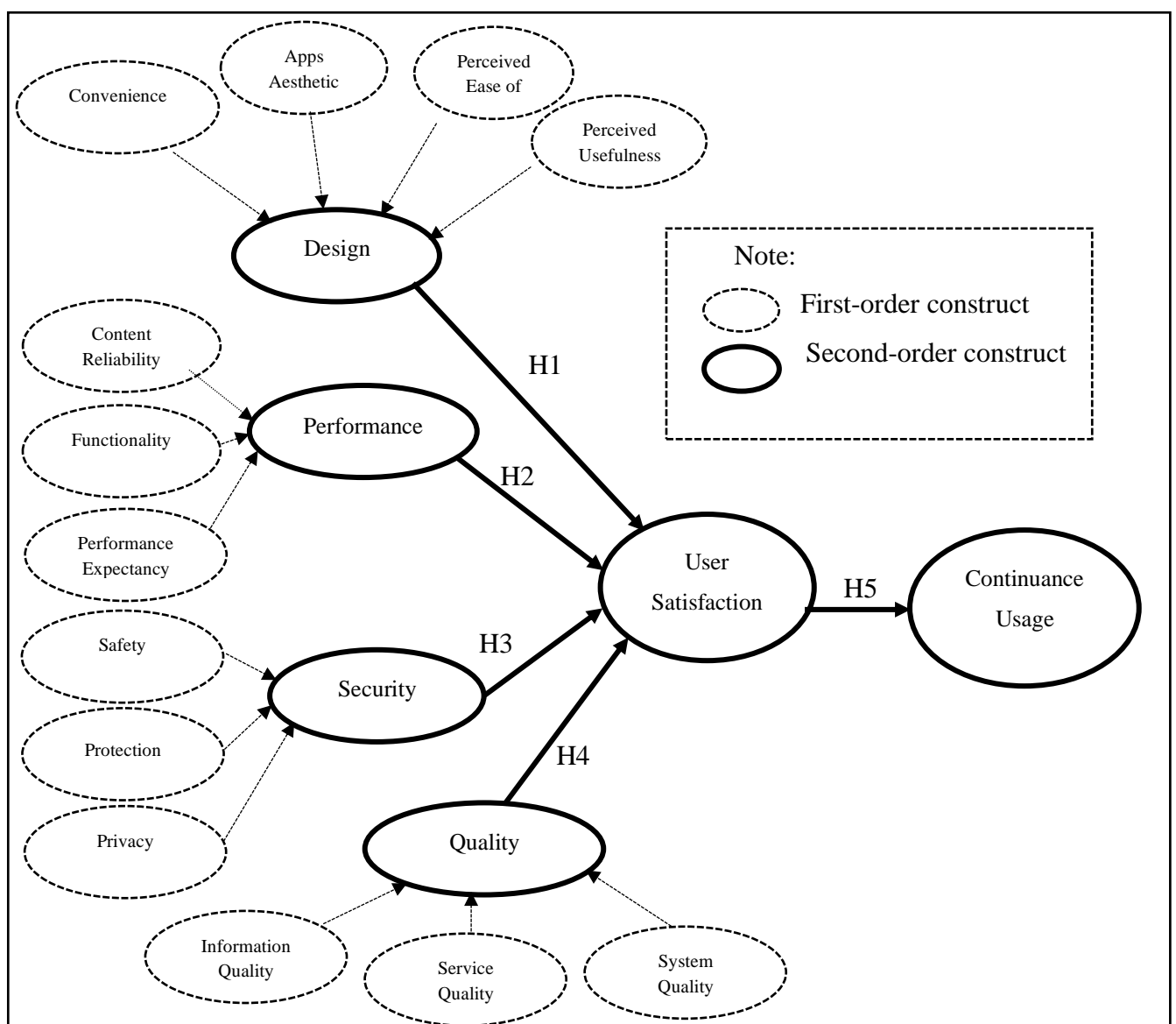


Figure 1: Proposed Framework

3. Research Methodology

This study used a quantitative approach, and the data were obtained from the users of MySejahtera. This app is used as the official channel for the Malaysian COVID-19 immunisation programme, including registering for vaccination, receiving appointment dates, downloading the COVID-19 immunisation digital certificate, performing health self-assessment, and other features (Government of Malaysia, 2021). A survey questionnaire was distributed to determine the users' satisfaction and their perspectives on the continuance usage of MySejahtera among Malaysians. The specific questions were administered, and respondents had to rate their opinions on design, performance, security and quality of the app, user satisfaction, and continuance usage of MySejahtera.

Target Population – The target population for this study was all the MySejahtera users in Malaysia. They were selected as they have been using MySejahtera since the launch of the app by the former Malaysian Health Minister, Dr Adham Baba on April 20, 2020. MySejahtera was developed following Act 342, Prevention and Control of Infectious Diseases Act 1988. The app has been among the world's top-ranking COVID-19 apps downloaded in 2021 (Yeoh, 2021). As of July 2021, MySejahtera has 27.7 million active registered users and 2.44 million registered business premises (Juani Munir Abu Bakar, 2021).

Sampling Design – Non-probability sampling was used to develop the potential sample. This study used convenience sampling to distribute the survey questionnaire in collecting the primary data. The respondents were informed that their participation in the survey questionnaire is voluntary and would be treated as private and confidential.

Sampling Size – This study needed to use sampling because the population was large and the distribution of questionnaires to the whole target population was impossible. Using the rule of 10 times by Hair et al. (2011), the minimum sample should be either 10 times the highest formative indicator in measuring a construct or 10 times the highest number of structural paths pointing at a particular latent construct. In addition, Memon et al. (2020) suggested that a sample size of 150 to 300 is sufficient for multivariate statistical analysis.

Data Collection – The questionnaires were distributed to the target respondents in *Bahasa Melayu* and English. The data were collected from the users of MySejahtera residing in Kuala Lumpur (the Capital of Malaysia), Klang Valley (Central Region), Penang (Northern Region), Perak (Northern region), Johor (Southern Region), and Kelantan (Eastern Region). The data collected from the different regions in Malaysia could produce more robust findings than those from a specific state.

4. Data Analysis and Findings

The collected data were analysed using partial least squares structural equation modelling. A total of 215 respondents participated in this study. The demographic data are presented in Table 1. It shows that the majority of the respondents were female representing 64% of the total respondents. Most of them were between the age of 18-24 years old and the least were aged more than 55 years old. Furthermore, 210 of them were Malaysians and only 5 respondents were non-Malaysians. Table 1 also shows the respondents' education level, in which 135 respondents obtained a bachelor's degree, 36 were postgraduate holders, 27 obtained a certificate/diploma or pre-university, and 17 respondents were from secondary schools.

Table 1: Demographic Data

Demographic Profile	Details	Frequency	%
Gender	Male	77	35.8
	Female	138	64.2
Age	18-24 Years Old	98	45.6
	25-35 Years Old	37	17.2
	36-45 Years Old	42	19.5
	46-55 Years Old	28	13.0
	More Than 55 Years Old	10	4.7
Nationality	Malaysian	210	97.7
	Non-Malaysian	5	2.3
Education level	Secondary School	17	7.9
	Pre-University/Certificate/Diploma	27	12.6
	Undergraduate (Bachelor's Degree)	135	62.8
	Postgraduate (Doctorate/Master's Degree)	36	16.7

Next, respondents were asked about their satisfaction with the features and functions of MySejahtera. Figure 2 shows the results and displays the mean for the user satisfaction with the features and functions in MySejahtera. The respondents were strongly satisfied with the COVID-19 Vaccination function, followed by COVID-19 Status, Things to Know, and Things to Do. On the other hand, the respondents were strongly dissatisfied with Helpdesk, Standard Operating Procedure, and Behavioural Risk.

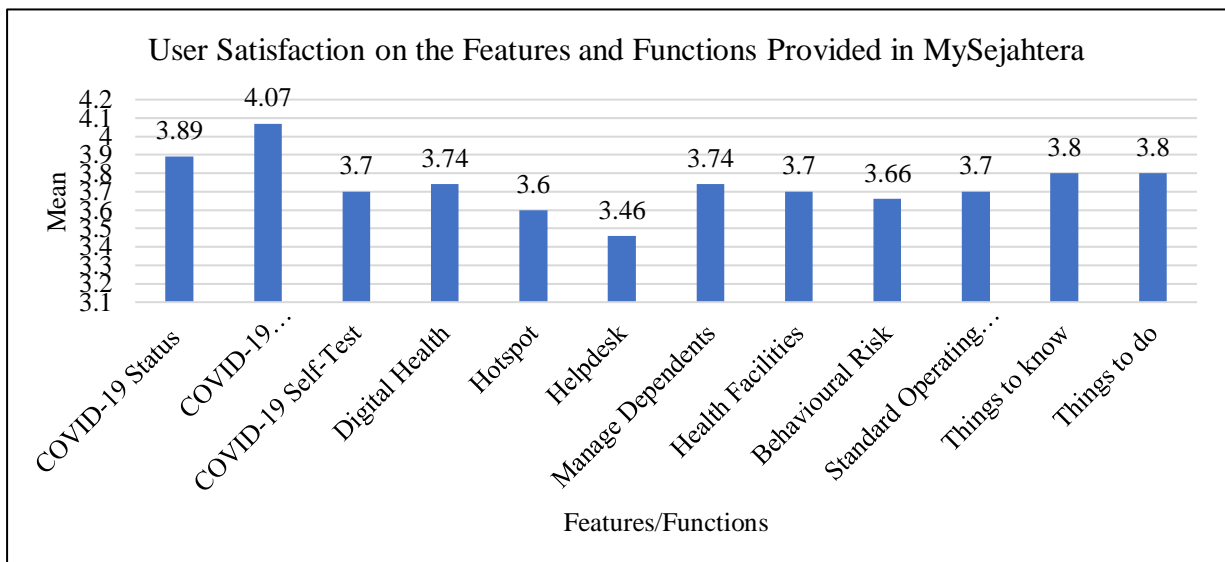


Figure 2: User Satisfaction with the Features and Functions of MySejahtera

Further statistical analysis was conducted by assessing the reliability and validity of the first-order constructs. Table 2 shows that the results meet the requirement of Cronbach's alpha, rho_A, composite reliability, and average variance extracted (AVE).

Table 2: Reliability and Validity Assessment of First-Order Constructs

First-Order Constructs	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Apps' Aesthetics	0.882	0.885	0.944	0.894
Convenience	0.921	0.921	0.95	0.864
PEOU	0.91	0.914	0.933	0.737
PU	0.936	0.937	0.951	0.795
Content Reliability	0.898	0.898	0.936	0.831
Functionality	0.799	0.802	0.909	0.833
Performance Expectancy	0.916	0.917	0.947	0.857
Privacy	1	1	1	1
Safety	0.912	0.912	0.958	0.919
Protection	1	1	1	1
Information	1	1	1	1
Service	0.938	0.938	0.955	0.843
System	0.906	0.906	0.955	0.914

The next statistical analysis was assessing the second-order constructs, and Table 3 presents the outcomes. The outcomes for the outer weights of all the first-order constructs were significant, and no collinearity issues arose because the variance inflation factors were below 5.

Table 3: Assessment of Second-Order Constructs

Second-Order Constructs	Dimensions	Outer Weight	Variance Inflation Factors
Design	Apps' Aesthetics	0.17***	2.80
	Convenience	0.24***	3.52
	PEOU	0.29***	4.18
	PU	0.38***	3.41
Performance	Content Reliability	0.39***	3.36
	Functionality	0.30***	3.77
	Performance Expectancy	0.38***	4.01
Security	Privacy	0.28***	4.11
	Safety	0.51***	3.13
	Protection	0.28***	4.99
Quality	Information	0.17***	3.43
	Service	0.44***	3.28
	System	0.46***	4.07

Note: ***p < 0.001

To examine the hypotheses, a bootstrapping procedure was executed. Table 4 shows the results. It was found that H2, H3, and H5 were supported while H1 and H4 were not supported. The

results indicated that the performance and quality of MySejahtera had a significant impact on users' satisfaction. The results further pointed out that user satisfaction will lead to the continuance of usage of MySejahtera. On the contrary, the design and security of MySejahtera did not influence user satisfaction.

Table 4: Results of Hypotheses Testing

Hypotheses	Path	Coefficients	T Statistics	P-value	Results
H1	Design -> User Satisfaction	0.16	1.563	0.12	Not Supported
H2	Performance -> User Satisfaction	0.41	3.444	0.00	Supported
H3	Quality -> User Satisfaction	0.40	3.729	0.00	Supported
H4	Security -> User Satisfaction	-0.05	0.857	0.39	Not Supported
H5	User Satisfaction -> Continuance Usage	0.84	31.315	0.00	Supported

Table 5 shows the R-square and Q-square results. The R-square of user satisfaction and continuance usage were 0.80 and 0.71, indicating substantial and moderate predictive accuracy, respectively. The Q-square of user satisfaction and continuance usage were 0.70 and 0.77, which reflected a large predictive relevance. Additionally, the exogenous variable in Table 5 shows that only user satisfaction had a strong effect size, whereas design, performance, quality, and security were weak.

Table 5: Results for Predictive Accuracy, Predictive Relevance, and Effect Size

Endogenous Constructs	R Square	Interpret (Predictive Accuracy)	Q Square	Interpret (Predictive Relevance)	Exogeneous Variable	F Square	Interpret (Effect Size)
Continuance Usage	0.71	Moderate	0.70	Large	User Satisfaction	2.42	Strong
User Satisfaction	0.80	Substantial	0.77	Large	Design	0.02	Weak
					Performance	0.08	Weak
					Quality	0.10	Weak
					Security	0.00	Weak

5. Discussions and Conclusion

The findings concluded that the users had the highest satisfaction with the function of the COVID-19 vaccination which includes registration, appointment date, and vaccination status. Notably, the vaccination procedure in MySejahtera is designed to ease the registration process, monitor the vaccine supplies from one dose to another, observe the vaccination centre along with updating the vaccination status. On the other hand, the current study concluded that the lowest satisfaction was on the helpdesk function. As an initiative to improve the helpdesk function and solve the issues on MySejahtera, a MySejahtera helpdesk kiosk was opened recently at the World Trade Centre in Kuala Lumpur.

This study concluded that the quality of MySejahtera with the dimensions of system quality, service quality, and information quality had a positive significant influence on user satisfaction. The good quality m-health apps will increase customer satisfaction. Since users are dependent on the apps, the quality provided become a major concern to the users. In addition, the results revealed that the performance of MySejahtera which comprises content reliability, functionality, and performance expectancy had positively affected user satisfaction. The result implies that a solid foundation of information provided in MySejahtera and appropriate functions that fulfil the user expectation are essential aspects in determining user satisfaction. The outcomes from this study proved that user satisfaction positively influenced the continuance usage of MySejahtera. Despite the non-mandatory usage of MySejahtera for contact tracing and identifying the vaccine status, it is believed that users will still use MySejahtera for other purposes such as obtaining information and clinic booking appointments. The study suggests that improvements from time to time on the information and functions of MySejahtera can increase user satisfaction and affect continuance usage.

6. Implications

Drawing from the findings of this study, the developers of m-health apps need to focus on the quality and performance of the apps. Constant monitoring and regular updates of the m-health apps will be beneficial to the users. The government plays an important role to ensure that the performance and quality of MySejahtera will keep on improving. Investing in the m-health apps as a source of information will be valuable to the community.

The current study had integrated TAM, TRA, and DeLone and McLean model as the underlying theory. It provided new insight into user satisfaction. Most past studies concentrated on the acceptance and adoption of m-health. However, the current study investigated satisfaction and continuance usage which are important for future development. It is also worth highlighting that the current study suggested the antecedents of user satisfaction, which is classified into four categories namely quality, performance and security. This suggestion will give a better understanding of the antecedents of user satisfaction.

7. Limitations

There are several limitations to this study. First, the data collection was performed during the mandatory usage of MySejahtera. The result may be different if the data were collected during the non-mandatory usage of MySejahtera. Hence, it is recommended to conduct the research during the non-mandatory usage of MySejahtera for comparison. Second, the study only focused on user satisfaction and continuance usage of Mysejahtera. Future studies may investigate another perspective of m-health apps such as from a clinical point of view.

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