

The Review of Malaysia Digital Health Service Mobile Applications' Usability Design

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Abstract—Digital health services have become a trend and receive higher demand in Malaysia. However, the adoption of mobile applications to support the digital health service in the country remains low especially among older adults, contributing to low usability support of the mobile applications. This paper reviews the usability models and design factors that are relevant and applicable to support the digital health service mobile applications' design for older adults. Seven usability design factors such as efficiency, help and documentation, learnability, memorability, user-friendliness, need-base, and push-base were discovered to be most suitable to support older adult users. Subsequently, a review was conducted on the fulfilment of seven usability design factors in key Malaysian digital health service mobile applications. Findings showed that most applications supported high learnability and memorability but lacked support for another five usability factors. Lastly, a usability design framework to support the Malaysia digital health service mobile applications for older adult users would be proposed. A full exploratory study is the next step to validate the proposed framework.

Keywords—Health system accessible; ISO/IEC9126; Nielsen usability model; older adults; usability

I. INTRODUCTION

Smartphones play a vital role in our daily lives by providing connection and computational power for individuals and communities. Other than the common phone functions such as making calls and sending messages, the applications in current smartphones also support various activities such as information search, travel navigation, online shopping, personal health tracking, and remote health monitoring. Currently, about 98.4% of Internet users aged 16 to 64 in Malaysia own a smartphone compared to only 7% of the same group of people who owned feature phones [1]. Although older adults have switched from using feature phones to smartphones, the interface of the existing smartphones commonly presents small font sizes and rich content that targets mainly young people and not older adults [2]. Older adults may have different smartphone usage preferences compared to younger adults. Older adults prefer browsing messages and social media posts related to news, economics, and health. They will also download applications that provide support services related to their daily chores. If mobile applications have low visibility and low learnability, it may hinder older adults from accessing information and services through mobile applications and browsers.

Digital healthcare has been gaining traction in Malaysia for the last decade. It has further accelerated rapidly since the COVID-19 pandemic period. According to Digital 2024 Malaysia [1], about a third of the population or about 10.16 million Malaysians used digital health treatment and care applications. However, the average annual value per user for digital treatment and care was only recorded at 18.72 USD in the year 2023. The first reason for the low valuation of use is related to the limited digital healthcare services offered in Malaysia such as MySejahtera, DoctorOnCall, PruBSN Navigator, Doctor2U by BP Healthcare, and GetDoc. Secondly, digital health service mobile applications are difficult to use. According to Alharbi et al. [3] and Tajudeen et al. [4], older adults faced several issues while using health service mobile applications such as a lack of understanding about the features and the know-how to complete tasks in the application such as to book a service or call for emergency help.

While the life expectancy in Malaysia for Malaysia in 2024 is 73.8 and above the average life expectancy at birth of the global population at 71 years [5], there are more elderly people in Malaysia who need digital health services accessibility. The baby boomer generation may require more assistance in using mobile applications on smartphones. Unfortunately, the mobile applications' design is not user-friendly for older adults. A limited mobile application usability study has been conducted and similarly, a limited usability design framework has been proposed to support the digital healthcare application's development for older adults. Many significant usability factors such as intuitive interfaces, personalization, and push-based support were lacking in the current digital health service mobile applications to support the older adults' needs [6], [7], [8].

This review aims to study the usability models and explore the missing factors that could be used to support older adults in Malaysia in adopting digital applications for their health and well-being. This review aims to address three research questions which are: 1) Which usability models or frameworks are applicable for digital health service mobile applications? 2) Which common usability factors are adopted in current digital mobile application studies? and 3) What are the usability factors related to older adults that should be integrated into digital health service mobile applications? This review will conclude with a proposed usability design framework to

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support the creation of healthcare mobile applications targeted at older adults.

This review paper has five main sections. Section I highlights the importance of supporting mobile application usability for older adults. Section II describes the methodology for conducting review activities. The findings of the review are explained in Section III. Follow on, a discussion of the findings of the review is written in Section IV before the conclusion and future work of this research are given in Section V.

II. METHODOLOGY

This review focuses on three key aspects. First, the existing technology acceptance models and usability frameworks are explored to determine the usability design factors. Second, the usability theory papers, existing conferences and journal publications related to usability evaluation of mobile applications that focus on digital health service applications are collected, synthesized, and summarized. Third, the existing digital healthcare mobile applications in Malaysia are explored and analyzed to determine the coverage of usability support in the applications. The search and review were conducted using Internet searches through the Google Scholar website and Google Play store dated from the year 2016 to 2024. The review duration covered the last 8 years of publications and mobile applications. In some cases, older references which are significant and impactful were also referred to and adopted.

III. FINDINGS OF THE REVIEW

The findings are presented based on the respective research question:

A. Findings on Research Question 1: Which Usability Frameworks are Applicable for Digital Health Service Mobile Applications?

Several theoretical frameworks and models were found to be relevant for digital health service mobile applications. The Technology Acceptance Model (TAM) proposed by Davis [9] is the foundational framework for understanding user acceptance of technology. It comprises two key determinants such as perceived usefulness and perceived ease of use which influence users' attitudes and actual intention to use technology (refer to Fig. 1). Current research still adopted this TAM to study the usability and acceptance of mobile applications such as mobile banking for Islamic banks [10], mobile e-wallets in Vietnam [11], and online food delivery applications [12].

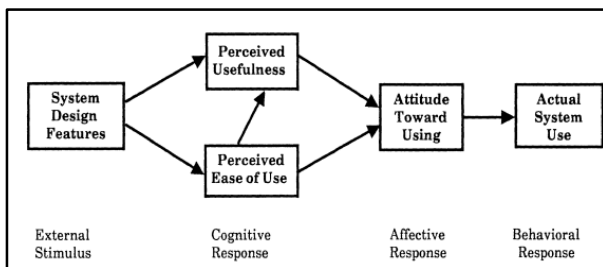


Fig. 1. Technology acceptance model (TAM) [9].

The TAM is incorporated into the Unified Theory of Acceptance and Use of Technology (UTAUT) model which was developed by Venkatesh et al. [13], together with the

Theory of Reasoned Action (TRA) to provide a comprehensive understanding of the factors influencing the acceptance and usage of technology. The original UTAUT model as shown in Fig. 2, has four key determinants namely performance expectancy, effort expectancy, social influence, and facilitating conditions. Furthermore, this UTAUT model has been extended with usability attributes by Alshehri et al. [14] to cover more aspects of mobile application users' behavioural study. Besides the original four key determinants in the UTAUT model, six usability attributes namely system navigation, information quality, system learnability, visual design, system interactivity, and instructional assessment were included in the extended UTAUT model (refer to Fig. 3). The study could be moderated with demographic variables such as age, experience, gender, and willingness to use. These usability attributes were also popularly used and validated extensively in previous system evaluation studies [15], [16], [17], [18], [19]. This extended UTAUT model was adopted by Semiz & Semiz [20] who discovered that facilitating conditions attribute was the most significant factor, which affected the usage of mobile health applications.

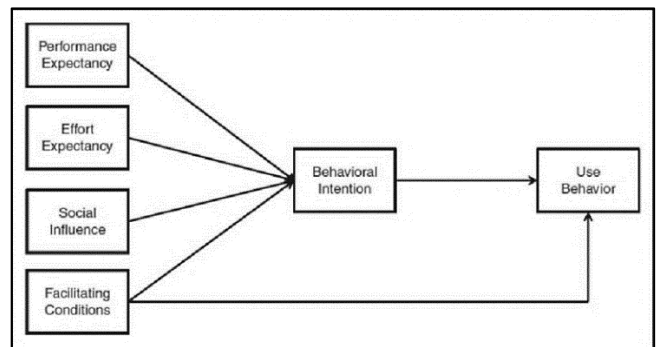


Fig. 2. UTAUT model [21].

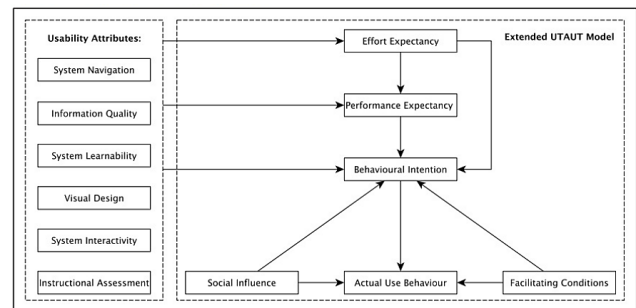


Fig. 3. UTAUT model with extended usability [14].

There are other usability theories and concepts proposed by other researchers. Nielsen proposed five quality components to support usability design [22]. The five quality components are learnability, efficiency, memorability, errors, and satisfaction. Much research was conducted and showed that the five quality components were significant in increasing the usability level of a product or system. The findings are summarized in Table I.

Nielsen also developed the Ten Principles of the Nielsen Usability Model [29]. Each principle provides insights and guidance for mobile applications, websites, and system designers to create user-friendly products to ensure that users can interact with the products efficiently and effectively. The

definition, applicability area for each of the principles, and the relevant research conducted are summarized in Table II.

TABLE I. SUMMARY OF RESEARCH FINDINGS FOR NIELSEN'S FIVE QUALITY COMPONENTS

| Quality component | Definition of the Component | Supported research |
|-------------------|--|------------------------------------|
| Learnability | Refers to the ease of intended task accomplishment during the user's initial use of a software application | [23], [24], [25], [26], [27], [28] |
| Efficiency | Refers to the productivity level of using the system. | [23], [26], [27], [28] |
| Memorability | Refers to how easy to remember the system's functionalities and operations for users who return after having been on vacation or temporarily stopped using a program | [23], [26], [28] |
| Errors | Refers to any action that does not accomplish the desired goal | [23], [26], [27], [28] |
| Satisfaction | Refers to how pleasant the user is when using the system | [26], [27], [28] |

TABLE II. OVERALL FINDINGS OF THE TEN PRINCIPLES OF NIELSEN USABILITY MODE

| Principle | Definition | Applicability area | Supported research |
|---|---|--|--------------------|
| Visibility of system | Refers to how well the system is conveyed to users | <ul style="list-style-type: none"> Keep the users updated about what is going on, what is the latest status, where are the user located. Support dynamic change of visuals and icons to highlight actions made. Clarity of display messages. | [30], [31] |
| Match between system and the real world | Refers to the natural mapping, which is easier for users to learn, use and remember how the interface and system works | <ul style="list-style-type: none"> The UI element will reflect material objects similar to those objects from the real world. Arrange the menu option and choose the color according to user's usual expectations. The icons should convey information about their functions. | [32], [33], [34] |
| User control and freedom | Refers to the ability to allow users to rectify their mistake or backtrack their action such as back, cancel or undo. | <ul style="list-style-type: none"> Provide browser back button. The system "Exit" should be easy to find to let users in control when can they want to leave the system. | [34], [35] |
| Consistency and standards | Refers to the standardization of all the buttons and designs that exist in the system to lower the user's learning curve. | <ul style="list-style-type: none"> Do not require the users to learn new interactions. Follow established standards to make mobile interface design familiar to the users. | [31], [36], [37] |

| | | | |
|---|---|--|------------|
| Error prevention | Refers to the effort to prevent users from making errors in the system. | <ul style="list-style-type: none"> Eliminate error-prone conditions Offer user confirmation before committing the action. Use a placeholder and provide a range for data entry to eliminate data entry error. | [23], [34] |
| Recognition rather than recall | Refers to the effort to reduce the memory load of a user by making elements, actions, and options visible | <ul style="list-style-type: none"> The information should be visible or easily retrieved when needed | [24], [38] |
| Flexibility and efficiency of use | Refers to the allowance of the user to use multiple interaction ways with the same result or task | <ul style="list-style-type: none"> Allow the use of a shortcut key to reduce the number of clicks. Define functional keys for the convenience of working with a system. | [24], [39] |
| Aesthetic and minimalist design | Refers to the design which consists of essential elements that support primary goals only. | <ul style="list-style-type: none"> Hide rarely used or irrelevant page or module. Encourage to use larger text and controls with lesser components in interface design. | [40], [41] |
| Help users recognise, diagnose, and recover from errors | Refers to the support given to help the users to recognise the errors and correct them. | <ul style="list-style-type: none"> Provide meaningful error messages with plain language and not an error code. Provide constructive suggestions to help the users to recover from the errors. | [34], [42] |
| Help and documentations | Refers to the availability of documentation that help users to better understand the system and know how to complete their tasks. | <ul style="list-style-type: none"> Provide documents that contain a list of concrete steps that need to be carried out to complete a task. Provide proactive help like tooltips, pop-up hints, and alert messages. | [24], [43] |

Besides, the International Organization for Standardization (ISO) also created the ISO/IEC9126 matrix for information technology to evaluate their software quality in 1991 [44]. This matrix was expanded from year 2001 to 2004 to include the ISO quality model. Table III shows the five product quality characteristics in the ISO/IEC9126 matrix and their sub-characteristics. In the matrix, usability can be further explored in five aspects: understandability, learnability, operability, attractiveness, and usability compliance. Some of the sub-characteristics matched the quality components proposed by Nielsen. This matrix has been used by some researchers to investigate the system or software design efficacy towards the acceptance of users [45], [46].

TABLE III. CHARACTERISTICS OF ISO/IEC9126 MATRIX

| Quality characteristic | Sub-characteristics |
|------------------------------|--|
| Functionality | <ul style="list-style-type: none"> Suitability Accuracy Security Interoperability Functionality compliance |
| Reliability | <ul style="list-style-type: none"> Maturity Fault tolerance Recoverability Reliability compliance |
| Usability | <ul style="list-style-type: none"> Understandability Learnability Operability Attractiveness Usability compliance |
| Efficiency | <ul style="list-style-type: none"> Time behavior Resource behavior Efficiency compliance |
| Portability /Maintainability | <ul style="list-style-type: none"> Analyzability Changeability Stability Testability Maintainability compliances |

In conclusion, six related usability frameworks were studied and showed high applicability to be adopted in the digital health service mobile application design. Each framework proposed different variables. For example, TAM has two determinant variables; the UTAUT model has four key determinants; the extended UTAUT model has six usability attributes; Nielsen proposed five quality components as well as ten principles of the usability model; and the ISO/IEC9126 matrix comprises usability as product quality characteristic with five sub-characteristics. Each framework or model has been validated and used in various research. They are highly applicable in various types of mobile applications and web

systems. Therefore, it is believed that these usability frameworks are significant and suitable for digital health service mobile application designs.

B. Findings on Research Question 2: Which Common Usability Factors are Adopted in Current Digital Mobile Application Studies?

A search was conducted on the Google Scholar website to explore the usability factors used in current digital mobile application studies. The search was conducted with keywords such as “mobile application”, “usability”, “user satisfaction”, and “user acceptance”. The search was filtered to include the recent 8 years’ research publications from 2016 to the current. The initial result returned 26,200 articles. The search results were later filtered to exclude duplicates, incomplete (pre-print, no full-text), and no usability factors as related to Research Question 1 finding, qualitative studies or studies with social science research frameworks. From the search conducted, 2006 hits were obtained and after applying filters, a total of 16 full-text articles were obtained. The mapping of 26 usability factors explored in the 16 current mobile application studies is displayed in Table IV.

The mapping in Table IV showed that efficiency, satisfaction, error, and effectiveness were the common usability factors used in existing studies. These variables were derived from Nielsen’s five quality components and ISO/IEC 9126 matrix. Other variables from TAM, UTAUT, and Nielsen’s ten principles of usability models such as learnability, ease of use, help and documentation, and visibility of system status were also adopted by the researchers. There are also some low-popularity variables such as need-base, good mapping, feedback, recognition rather than recall, consistency and standard, operability, and flexibility as displayed in Table IV.

TABLE IV. MAPPING OF USABILITY FACTORS TO CURRENT MOBILE APPLICATION STUDIES

| Paper/ Variable | Need Base | Visibility of system status | Error | Consistency | Memorability | Recognition rather than recall | Ease of use | Effectiveness | Satisfaction | Learnability | Efficiency | Help and Documentation | Usefulness | Attitude or Likeability | Good conceptual Model | Good Mapping | Feedback | Security | Cognitive Load | Consistency and Standard | Privacy | Design | Accessibility | Aesthetics | Operability | Flexibility |
|-----------------|-----------|-----------------------------|-------|-------------|--------------|--------------------------------|-------------|---------------|--------------|--------------|------------|------------------------|------------|-------------------------|-----------------------|--------------|----------|----------|----------------|--------------------------|---------|--------|---------------|------------|-------------|-------------|
| [23] | | | | | | | ✓ | ✓ | ✓ | | ✓ | | | | | | | | | | | | | | | |
| [24] | | ✓ | ✓ | | | ✓ | ✓ | | | | | ✓ | | | | | | | | | | | | | | |
| [26] | | | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | | | | |
| [27] | | | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | | | | |
| [28] | | | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | | | | | | | | | | | | | | | |
| [31] | ✓ | ✓ | | | | | | | | | | | | | | | | | | | | | | | | |
| [34] | | | | | | | | | | | | ✓ | | | | | | | | | | | | | | |
| [37] | | | | | | | | | | | | ✓ | | | | | | | | ✓ | | | | | | |
| [47] | | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | |
| [48] | | | | | | | ✓ | ✓ | | | | | | | | | | | | | | | | | | |
| [49] | | | ✓ | | | | | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ | | | | |
| [50] | | | ✓ | | ✓ | | | ✓ | ✓ | | ✓ | | ✓ | | | | | | | | | | ✓ | ✓ | ✓ | |
| [51] | | ✓ | ✓ | ✓ | ✓ | | | | | | | ✓ | | | | | | | | | | | ✓ | ✓ | | ✓ |
| [52] | | | | | | | | ✓ | ✓ | | ✓ | | | | | | | | | | | | | | | |
| [53] | | | | | | | | ✓ | ✓ | | ✓ | | | | | | | | | | | | | | | |
| [54] | | | | | | | | ✓ | ✓ | | ✓ | | | | | | | | | | | | | | | |
| Variable count | 1 | 4 | 8 | 1 | 6 | 1 | 4 | 8 | 10 | 5 | 10 | 4 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 |

The 16 current mobile application studies focused mainly on applications with general users of all ages. These studies did not focus on the usability considerations for older adult users. For example, variables such as need-base, feedback, and accessibility that are assumed to be more relevant to older adult users were not explored adequately nor adopted in the current studies. It may be due to the nature of mobile applications that generally do not target older adult users, or researchers and developers may have neglected this group of users.

C. Findings on Research Question 3: What are the Usability Factors Related to Older Adults that Should be Adopted in the Digital Health Service Mobile Applications?

Based on the analysis and findings from Research Questions 1 and 2 above along with other relevant studies, seven usability factors were identified to support digital health service mobile applications that targeted older adult users. The factors were presented to a professional healthcare service provider and an industry-experienced user interface & user experience (UI&UX) developer to obtain their views on the usability factors' applicability to digital health service mobile application's design. Both experts agreed that this set of usability factors is relevant and suitable in Malaysia's context. The professional healthcare service provider also proposed two new variables (need-base and push-base) to be included, which do not belong to any existing usability model or framework, but are highly important for older adult users. Based on the input provided by both experts, the rationale for including the seven usability factors in digital health service mobile applications is derived and explained in Table V.

To examine whether the current studies have adopted the proposed usability factors for older adult users' support, the previous Table IV is filtered to show the studies that supported the seven proposed usability factors. The findings are displayed in Table VI. The filtering discovered that all 16 current studies included at least one of the usability factors that support older adult users, except for the push-base factor. A few current studies such as [26], [27], [28], [47] supported up to four usability factors for older adult users. The need-base and push-base factors are rarely or not supported by the current studies.

On the other hand, the researchers also reviewed the existing Malaysia-based digital health service mobile

applications on the adoption of the seven proposed usability factors as presented in Table V. The review was conducted for six mobile applications namely MySejahtera [55], DoctorOnCall [56], BookDoc [57], PruBSN navigator [58], doctor2u By BP healthCare [59], and GetDoc [60]. The findings are shown in Table VII.

The digital health service mobile application that adopted the greatest number of usability factors for older adult support is doctor2u by BP Healthcare (Table VII). The mobile application only lacked the push-base component. The most downloaded health service mobile application in Malaysia – MySejahtera also fulfilled five usability factors for older adult support. Similarly, this mobile application also did not support push-base component, as well as the need-base component. The MySejahtera was created to support Malaysia COVID-19 pandemic healthcare activities such as health monitoring and vaccination. This mobile application was mandatory to be used by citizens of all ages in Malaysia during the movement control order period. Therefore, it is justifiable that the MySejahtera application's design has a high usability level to support older adult users. On the other hand, BookDoc, which is a personalised health and wellness mobile application for enhanced well-being is more dedicated to younger users and therefore only fulfilled one usability factor of high learnability related to older adult users.

In conclusion, the evaluation of various health service mobile applications revealed the shortcomings of the usability design in different aspects for older adult users. The help and documentation, learnability, and memorability design factors are well-adopted by current health service mobile applications. Meanwhile, the efficiency and user-friendliness design factors are only adopted by half of the current mobile applications. On the other hand, the need-base and push-base factors are only adopted by one mobile application reviewed. These findings indicate that most of the current health service mobile applications in Malaysia are not older adult-friendly in design. Currently, no Malaysian mobile applications for health adopted a similar design framework also. This implies a lack of standard usability design framework for health service mobile applications, especially to support older adult users.

TABLE V. RATIONALE FOR USABILITY FACTORS INCLUSION IN DIGITAL HEALTH SERVICE MOBILE APPLICATIONS

| Variable | Rationale |
|------------------------|---|
| Efficiency | Older adult users have lower attention span due to eye tiredness. The mobile application must support fast and timely task completion. |
| Help and documentation | Older adults may not be familiar with mobile application's functionalities and layout, a step-by-step documentation guide or responsive help in the mobile applications will help them to use the mobile application independently. |
| Learnability | Older adults may not have high digital literacy skills. The mobile application operations must be easy to learn and fast to pick up by the older adult users. |
| Memorability | Older adults may not remember as quickly or efficiently compared to younger adults. The mobile application should reduce the need for recall on how to use the mobile application's functions for older adults |
| User-friendliness | The mobile application should provide user-friendly components such as bigger fonts, suitable font colors and contrast, bigger buttons, and navigation controls to allow older adult users to view, click, and navigate the mobile application contents smoothly. |
| Need-base | Older adults may have special needs for features such as error prompting and correction guides, automated settings, and shortcuts that may not be required by younger age users. |
| Push-base | Older adults may have special needs for features such as service alerts and health reminders that may not be required by normal-age users. |

TABLE VI. MAPPING OF CURRENT MOBILE APPLICATION STUDIES TO USABILITY FACTORS FOR ELDERLY SUPPORT

| Paper | Efficiency | Help and documentation | Learnability | Memorability | User-Friendliness | Need - Base | Push-Base | Total fulfilment |
|-------|------------|------------------------|--------------|--------------|-------------------|-------------|-----------|------------------|
| [23] | ✓ | ✗ | ✗ | ✗ | ✓ | ✗ | ✗ | 2 |
| [24] | ✗ | ✓ | ✗ | ✗ | ✗ | ✗ | ✗ | 1 |
| [26] | ✗ | ✓ | ✓ | ✓ | ✓ | ✗ | ✗ | 4 |
| [27] | ✓ | ✗ | ✓ | ✓ | ✓ | ✗ | ✗ | 4 |
| [28] | ✓ | ✗ | ✓ | ✓ | ✓ | ✗ | ✗ | 4 |
| [31] | ✗ | ✗ | ✗ | ✗ | ✗ | ✓ | ✗ | 1 |
| [34] | ✗ | ✓ | ✗ | ✗ | ✗ | ✗ | ✗ | 1 |
| [37] | ✗ | ✓ | ✗ | ✗ | ✗ | ✗ | ✗ | 1 |
| [47] | ✓ | ✗ | ✓ | ✓ | ✓ | ✗ | ✗ | 4 |
| [49] | ✓ | ✗ | ✓ | ✗ | ✓ | ✗ | ✗ | 3 |
| [48] | ✗ | ✗ | ✗ | ✗ | ✓ | ✗ | ✗ | 1 |
| [50] | ✓ | ✗ | ✗ | ✓ | ✓ | ✗ | ✗ | 3 |
| [51] | ✗ | ✓ | ✗ | ✓ | ✗ | ✗ | ✗ | 2 |
| [52] | ✓ | ✗ | ✗ | ✗ | ✓ | ✗ | ✗ | 2 |
| [53] | ✓ | ✗ | ✗ | ✗ | ✓ | ✗ | ✗ | 2 |
| [54] | ✓ | ✗ | ✗ | ✗ | ✓ | ✗ | ✗ | 2 |

TABLE VII. ANALYSIS OF MALAYSIA-BASED DIGITAL HEALTH SERVICE MOBILE APPLICATION IN USABILITY FACTORS' COVERAGE

| Application | Efficiency | Help and documentation | Learnability | Memorability | User-Friendliness | Need - Base | Push-Base | Total fulfilment |
|--------------------------------|------------|------------------------|--------------|--------------|-------------------|-------------|-----------|------------------|
| MySejahtera [55] | YES | YES | YES | YES | YES | NO | NO | 5 |
| DoctorOnCall [56] | YES | YES | NO | YES | NO | NO | YES | 4 |
| BookDoc [57] | NO | NO | YES | NO | NO | NO | NO | 1 |
| PruBSN navigator [58] | NO | NO | YES | YES | NO | NO | NO | 2 |
| doctor2u By BP Healthcare [59] | YES | YES | YES | YES | YES | YES | NO | 6 |
| GetDoc [60] | NO | YES | YES | YES | YES | NO | NO | 4 |

IV. DISCUSSION

This study discovered that the popular usability models adopted among the researchers are the Nielsen five quality components and ISO/IEC 9126 matrix. The researchers acknowledged the importance of having high usability coverage in the mobile application design to fulfil the specific users' needs and increase user satisfaction and experience. Research Questions 2 and 3 findings show different focuses on usability factors' adoption for general and health service mobile applications. It showed that the health service mobile application developers realised that the special-needs mobile application must have a unique set of usability factors to support the users. However, this awareness needs to be further strengthened to assist older adult users by considering more unique and related usability factors.

V. CONCLUSION

This study addressed three key research questions by using different approaches with reference to 43 significant research papers available in Google Scholar from the year 2016-2024. A theoretical study was conducted to identify and determine the

relevant usability frameworks and models with the usability design factors to answer Research Question 1. As for Research Question 2, literature research was conducted in Google Scholar to explore the existing usability research for mobile applications in the past eight years. Studies adopted a different usability model for the mobile applications' design. It is observed that the Nielsen five quality components and ISO/IEC 9126 matrix are most adopted by researchers. Finally, to answer Research Question 3, seven usability factors were carefully selected and verified by the experts such as efficiency, help and documentation, learnability, memorability, user-friendliness, need-base, and push-base. Comparative analysis was also conducted on the existing 16 research papers and six Malaysia health service mobile applications. Overall, the fulfilment of usability factors to support older adult users was averagely low. This research identified the gap in determining the usability design framework that could be applied to mobile application design for older adults. This research is only limited to exploring the needs of older adults in the country of Malaysia as a pioneer study.

As the proposed usability design framework for older adult users is only preliminarily verified and agreed upon by two

experts, it is necessary to conduct a full exploratory study among the health service mobile application's older adult users to assess their agreement on the usability factors. The development of a health service mobile application prototype that covers the seven proposed usability factors as a proof-of-concept product for the older adult users' exploration is highly recommended. A quantitative analysis could then be conducted to measure the relationships between the seven usability factors and the acceptance or satisfaction level of health service mobile applications among older adult users. It is expected that once this future work is completed, a usability design framework to support health service mobile applications for elderly users could be proposed and adopted in Malaysia. This effort would increase Malaysian older adults' health system accessibility rate and digital healthcare value in Malaysia too.

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