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The influence of digital literacy on mHealth app usability: The mediating role of patient expertise

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Abstract

Objective: Mobile health (mHealth) applications are emerging as important healthcare technologies that can provide cost savings, better access to care, contribute to improved clinical outcomes, and support public health. An increasing number of mobile health (mHealth) applications are becoming available to download and use on mobile devices. However, unlocking this potential requires ensuring widespread acceptance and adoption of these applications. In this context, the aim of the study is to determine the impact of individuals' digital literacy levels on mobile health application usability and the mediating role of patient expertise in this impact.

Methods: The population of our study consists of individuals who reside in Yozgat city center and are 18 years old and over. Within the scope of the study, 647 individuals who agreed to participate in the research were reached. A survey form consisting of four sections (Socio-demographic characteristics, Digital Literacy Scale, mHealth App Usability Questionnaire, and Patient Expertise Scale) was used as a data collection tool in the study. Descriptive statistical methods were used to analyze the data and partial least squares path analysis (PLS-SEM) was used to analyze the research model.

Results: Digital literacy affects both patient expertise ($\beta = 0.790$, $t = 35.560$, $p = 0.000$) and mHealth app usability ($\beta = 0.831$, $t = 46.020$, $p = 0.000$). Additionally, it has been determined that patient expertise has a mediating role in the effect of digital literacy on mHealth app usability ($\beta = 0.536$, $t = 17.477$, $p = 0.000$).

Conclusions: It appears that individuals' digital literacy is an important precursor to the usability of mHealth apps and increases their usage experience. In this sense, it is thought that the concept of digital literacy can be used to increase the usability of mHealth apps for individuals. Overall, the findings provide new evidence for the healthcare context by integrating user diversity, particularly individuals' digital literacy, mHealth apps, and prior experience with mHealth.

Keywords

Digital literacy, mHealth, patient expertise, eHealth, mobile apps, mHealth apps, usability, health information

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Introduction

Today, individuals have started to use technology intensively. While the global number of internet users is 5.3 billion people,[1] in Turkey, 95.5% of the total population utilizes the internet.[2] The rise in this number in recent times can be attributed significantly to the widespread use of personal cell phones. The World Economic Forum (WEF)[3] report states that there are more cell phones than the world population. With the increasing use of technology and the internet, people have tried to adapt to the digital ecosystem. This growth has led to an increase in smartphone usage worldwide.[4] In this way, people use various mobile apps that have become important in their decision-

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making. Through mobile apps, people obtain a lot of information and gain access to various processes that need to be followed. However, just because they have the relevant technology does not mean they are using it correctly. For this, they need to have different literacies. Literacy levels[5] and the prevalence of literacy in the population, which used to be included in the assessment of the development level of a region or a nation, have recently started to be addressed more specifically. These include financial literacy,[6] media literacy,[7] health literacy,[8] and digital literacy.[9] Over the past decade, there has been a growing academic and social interest in these subjects, because they are crucial for people to make decisions about their health, finances, and lives.

Right here, digital literacy can be more prominent than others. Digital literacy is regarded as a life skill in the current era.[10] Digital literacy, defined as the ability to access, understand, and use digital technologies effectively, plays an important role in shaping how patients interact with mHealth apps.[11] Individuals can better adapt themselves to evolving technologies through digital literacy. For instance, the recent surge in digitalization within the healthcare sector and its prevalent adoption can be associated with individuals' digital literacy. Among the elements of digitalization are various apps and uses such as online health, telemedicine, telehealth, mobile health (mHealth), and virtual reality.[12,13] Moreover, individuals with higher levels of digital literacy may be more proactive in seeking health information, exhibiting self-management behaviors, and participating in joint decision-making processes with healthcare providers.[14] In the context of mHealth, digital literacy enables users to navigate the interface, interpret health information, engage with interactive features, and communicate with healthcare providers.[15,16] Individuals with higher levels of digital literacy tend to exhibit greater confidence and competence in navigating digital platforms, including mHealth apps.[17] Conversely, those with lower digital literacy may face barriers such as difficulty in understanding app functions or interpreting health-related information presented in the app interface.[18]

At this point, individuals' consumer expertise can contribute to the development of digital literacy. This is because individuals can develop the skills required to access health-related information and utilize digital health resources, thus potentially increasing their level of digital literacy.[19] Patient expertise is defined as experiential knowledge gained from personally managing the day-to-day experience of illness.[20] Patient expertise is related to individuals' knowledge, skills, and experience in managing their health status and using health resources.[21] Patient expertise influences how individuals interact with mHealth apps and their ability to derive benefits from these tools.[22] This can be attributed to individuals' experiences, whether positive or negative, with the services they receive. Individuals who have more experience with the services they receive can better examine and understand details during their subsequent use.[20,23,24] Conversely, those lacking expertise may adopt a more passive role due to their limited experience, potentially leading to incorrect assessments.[25] It is stated that this expertise plays an important role, especially in consumer behaviors.[26]

In this regard, the present study aims to determine the impact of individuals' digital literacy levels on mHealth app usability and the mediating role of patient expertise in this impact.

Theoretical framework

Digital literacy and patient expertise serve as individual-level determinants that can facilitate or hinder mHealth app usability.[27–29] In this context, it is crucial to consider the theoretical frameworks that illuminate the interplay between digital literacy, patient expertise, and mHealth app usability. The Technology Acceptance Model (TAM), proposed by Davis,[30] serves as a basic framework for understanding users' acceptance and adoption of technology. According to TAM, perceived ease of use and perceived usefulness significantly affect users' attitudes and intentions toward using technology. In this regard, both digital literacy and patient expertise influence mHealth app usability by contributing to users' perceptions of ease of use and usefulness.

Hypotheses

Digital literacy significantly influences mHealth app usability and serves as a cornerstone for effective engagement and use among users. Individuals with higher levels of digital literacy demonstrate greater competence in navigating the features and functionalities of mHealth apps, using of these tools to manage health and access relevant information.[28] Digital literacy encompasses a variety of skills, including the ability to critically evaluate online information, communicate effectively through digital channels, and navigate complex digital interfaces.[29]

H_1: Digital literacy influences mHealth app usability.

Digital literacy significantly influences patient expertise and shapes individuals' ability to acquire, understand, and apply health-related information in digital environments. As patients interact with digital health platforms and mHealth apps, their level of digital literacy influences the depth and scope of their health-related knowledge, thereby contributing to the development of patient expertise.[31] Therefore, endeavors to enhance digital literacy among patients have the potential to strengthen patient expertise, enabling individuals to take a more active role in managing their health and to make informed healthcare decisions.

H_2: Digital literacy influences patient expertise.

Patient expertise, encompassing individuals' knowledge, skills, and understanding of their health status, treatment options, and self-management strategies, plays a critical role in shaping how users interact with mHealth apps.[28] Individuals with higher levels of patient expertise are better equipped to grasp the relevance and utility of the various features offered by mHealth apps, which enables them to effectively utilize functionalities such as symptom monitoring, medication management, and communication with healthcare providers.[29] Furthermore, patients with extensive expertise may show greater confidence in using these apps to monitor their health status, make informed decisions, and actively participate in their care process.[32] Therefore, it is crucial to understand and utilize patient expertise to enhance user interactions and satisfaction with mHealth apps, as well as to improve the overall effectiveness of digital health tools.

H_3: Patient expertise influences mHealth app usability.

The mediating role of patient expertise in the influence of digital literacy on mHealth app usability underscores the complex relationship between these factors in shaping users' experiences and interactions with digital health tools. Digital literacy equips users with the technical skills to navigate and use mHealth apps, while patient expertise influences their ability to interpret health-related information, make informed decisions, and interact effectively with the app's features.[32] In other words, while digital literacy facilitates users' navigation of these apps, patient expertise serves as a critical intermediary in maximizing their utility and effectiveness. Therefore, people with higher levels of patient expertise may demonstrate greater competence in utilizing the functionalities offered by mHealth apps, regardless of their level of digital literacy.

H_4: Patient expertise has a mediating role in the influence of digital literacy on mHealth app usability (Figure 1).

Method

Study design

This is a descriptive cross-sectional study as the data were collected during a short window of time and provides a snapshot of the issue. The study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for reporting.

Population and sample

The population of this study comprises individuals aged 18 and over residing in Yozgat city center, Türkiye. Meanwhile, volunteers in Yozgat city center were contacted on high streets, at hospital and pharmacy entrances/exits. The study employed random sampling, a probability sampling method, for sample selection. The sample size was calculated using the formula below.[33,34] According to the formula, a sample size of 384 was calculated to represent the population with a 95% confidence interval.

Upon informing about the study, voluntary participants were included in the study. Only one response per person was allowed. The apps can be found in Google Play or Apple Store by searching their names (Merkezi Hekim Randevu Sistemi (MHRS), E-Nabız, Hayat Eve Sığar (HES), İlaç Takip Sistemi (ITS), 112 Acil Yardım Butonu, Engelsiz Sağlık İletişim Merkezi (ESIM) et al.). All sample members were selected because they indicated

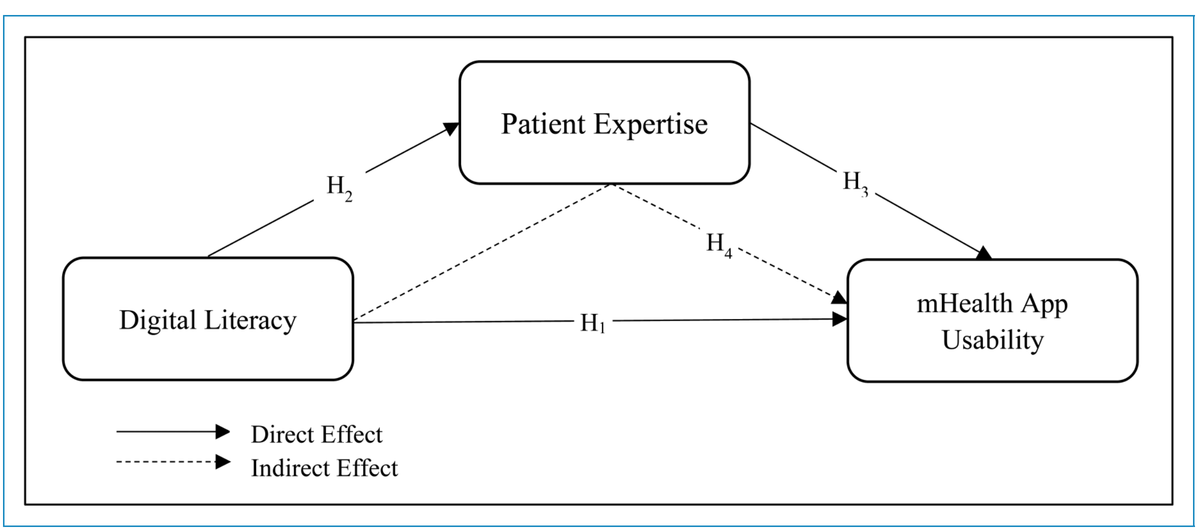

Figure 1. Research model.

that they had previously used mHealth apps and were aware of their functionality and traceability. They were informed about the other apps so that they could take into account additional features of the apps. The data were collected between 15.02.2024 and 15.03.2024 by face-to-face survey method. Within the scope of the study, 647 individuals who agreed to participate were reached.

Socio-demographic characteristics of the participants. 60.3% of the participants were female, and 39.7% were male. In terms of educational attainment, 46.2% had high school education or less, while 53.8% had associate's or bachelor's degrees. 38.5% of the participants were married, and 75.9% lived in the city. The mean age of the participants was 31.9 ± 14.3 years.

Inclusion criteria: Being 18 years of age or older, using a mHealth apps (Merkezi Hekim Randevu Sistemi (MHRS), E-Nabız, Hayat Eve Sığar (HES), İlaç Takip Sistemi (ITS), 112 Acil Yardım Butonu, Engelsiz Sağlık İletişim Merkezi (ESIM) et al.), being literate, and using a smartphone.

The subjects for this study were drawn from mHealth users. A screening self-report question was included in the survey to identify mHealth users. Participants were asked if they have ever used their smartphones for any health-related purposes, such as seeking health- and disease-related information online, texting messages for health-related purposes (such as reminders/alerts for appointments, taking medications, and consultations), and downloading and using any health-related apps (such as apps for health tracking and medication tracking). Participants who reported having used their smartphones at least for one of these purposes were included in the analysis.

Exclusion criteria: Being under 18 years of age, being illiterate, being unable to use a smartphone, and not having used any mHealth apps before.

Data collection process

The data collection tool was prepared in Turkish. Ethics committee permission was obtained for the research. Yozgat Bozok University Ethics Commission approved the research. (Date: March 7, 2023/ Decision No: 04.06). Data were collected between 15.02.2024 and 15.03.2024 by face-to-face survey method. Participation was voluntary where confidentiality was ensured, and provided written informed consent of the respondent was obtained before commencing the survey. In the introduction section of the questionnaire, a brief orientation on the topic of the study was given. The respondents were also reminded of their rights and informed on how the collected data would be dealt with. We encouraged them to answer freely, as there were neither "correct" nor "incorrect" answers, and we let them know that we were only interested in their perspective on this timely topic. Respondents were also informed that participation was voluntary and that they were free to quit at any time. The participants were allowed to be alone while filling out the questionnaire so that they would not feel under pressure. The form took an average of 10 minutes to complete, and the participants were not given any incentives.

Additionally, participants of different age groups were recruited. However, in accordance with the technical requirements of mHealth use, only participants with access to the internet and digital devices were targeted. Today, young people, in particular, use mHealth apps.[35] Therefore, an additional aim for recruitment was to reach those people who have the technological access and know-how to use mHealth apps.

Measurement tools. The study employed a questionnaire form comprising four sections to collect data. The questionnaire form is included in the attached file.

Socio-demographic characteristics: Details such as gender, age, marital status, educational status, and place of residence were obtained.

Digital Literacy Scale (DL): The scale developed by Ng[9] contains 10 statements (*sample statement: "I can learn new technologies easily"*) and one dimension. The Turkish adaptation of the scale was conducted by Üstündağ, Güneş, & Bahçivan.[36]

mHealth App Usability Questionnaire (MAUQ): The scale was developed by Zhou et al.[37] in 2019. It consists of 18 statements and three dimensions. The dimensions are ease of use (5 items; *sample statement: "The app was easy to use"*), interface and satisfaction (7 items; *sample statement: "I like the interface of the app"*), and usefulness (6 items; *sample statement: "The app would be useful for my health and well-being"*). The Turkish validity and reliability analysis of the scale was conducted by the author.

Patient Expertise Scale (PE): The scale, developed by Zou, Yu, & Hao,[26] was adapted to mobile healthcare services by Shan et al.[25] The scale consists of three statements *(sample statement: "I am knowledgeable about mHealth services")* and one dimension. The Turkish validity and reliability analysis of the scale was conducted by the author.

DLS, MAUQ, and PE were designed on a 5-point Likert scale (*1: strongly disagree, 5: strongly agree*). The participants were asked to mark the most relevant option in the form.

Turkish adaptation process. In the first stage, the scales were translated from English to Turkish by two academicians. The statements of the translated scales were evaluated by another academician and draft scales were created. Then, the scales were translated from Turkish to English by two academicians who had no knowledge of the original scales. The translated statements were compared with the original statements, it was determined that the meanings of the statements forming the scales did not differ from the statements of the original scales and it was decided to use the Turkish scales.

Then, the scope validity of the scales was performed. Content validity is carried out to determine the extent to which the entire scale and each item in the scale serve the purpose.[38] Lynn[39] stated that for content validity, it is appropriate to limit the number of experts to be consulted to a maximum of 10 people; consulting more experts may be unnecessary. In addition, when opinions from six or more experts are obtained, the content validity coefficient should not be lower than 0.78; in case nine experts are consulted, the coefficient should be at least 0.78, and having two unrelated scores will not negatively affect the content validity.[40] This coefficient is generally applied as 0.80 in studies.[38] In the study, content validity indexes were calculated using the Davis[41] technique. In this technique, expressions are evaluated as; a) "appropriate", b) "item should be slightly revised", c) "item should be seriously revised" and d) "item is not appropriate". As a result of expert evaluations, the number of "a" and "b" options selected by experts for each statement is divided by the number of experts who provided their opinions, and the content validity index is calculated. In the study, the expressions of the scales were evaluated by 6 experts for content validity. During the evaluation process, experts were asked to clearly write their opinions and suggestions about the statements and to suggest alternative expressions for the statements they did not find appropriate. As a result of the expert evaluation, the content validity index was calculated as 0.90 for all statements in the scales. According to this result, it was decided that the scales met the necessary conditions for content validity.

Then, the pilot application of the content validated scale was carried out. It is recommended that the pilot application should be implemented in a small group. There are views that this group should be between 5–10 and 50–100.[42] The final version of the scale was applied to 40 participants and they were asked to evaluate the clarity and comprehensibility of the questions. In the pilot study, the questions were found to be understandable and the data collection process was started without making any corrections.

Statistical analysis. Only completed surveys were considered for data analyses (listwise deletion). No imputation technique was used to compensate for missing values because the vast majority of dropouts occurred after the first 3 demographic questions (missing not at random). The data were analyzed using descriptive statistical methods, primarily with the Statistical Package for the Social Sciences (SPSS) program (version 24 - IBM Analytics), while partial least squares path analysis (PLS-SEM) was employed for analyzing the research model. Analyses were performed at 95% confidence interval ($p < 0.05$).

The study utilized structural equation modeling (SEM) with variance to conduct data analysis and hypothesis testing. This statistical approach enabled the examination of the interdependent relationships between the latent variables and observable variables in the research model.[43]

The technique of structural equation modeling (SEM) was employed together with the method of partial least squares (PLS). PLS trajectory modeling refers to a comprehensive structural equation modeling (SEM) approach used to analyze composite factor models. It involves measuring constructs, estimating structural models, and conducting model fitting tests.[44]

The PLS-SEM statistical analysis technique, which is based on the structural equation model, was employed due to its particular suitability for exploratory research. This method enables the representation of underlying concepts using indicators that either shape or reflect the construct, in order to assess the gathered data.[45] In addition, PLS is appropriate for the prediction and analysis of relatively new phenomena.[46] This study utilized SmartPLS 4 software (Version 4.1.0.1).[47]

Reinartz et al.[48] examined the circumstances in which PLS-SEM is appropriate for research analysis and determined that the approach can be utilized for a relatively novel research subject with a model that is not yet fully established. As these were the conditions in this research, we chose to use PLS–SEM. Besides, ours is an exploratory approach[49] for which this type of data analysis is highly recommended.[50]

The PLS-SEM technique was employed to assess the predictive capability of the model, as it was one of the research objectives. Chin and Newsted,[46] Fornell and Larcker,[51] and Hair et al.[52] had already shown that PLS–SEM can be used for this purpose.

Fornell and Bookstein[53] state that PLS explicitly delineates the latent variables, structures, or amalgamations that may be readily quantified. The use of these factors is another point that justifies the use of SEM, as shown in similar studies by Sarstedt et al.,[43] Henseler,[54] and Rigdon et al.[55]

Based on the research studies by Sarstedt et al.,[43] Hair et al.,[52] and Cepeda-Carrion et al.,[56] the choice of the best SEM approach depends on the type of latent variables being measured, with the aforesaid studies recommending PLS for reflective or common factor constructs. The information required to analyze these factors was found from other related variables, which is another condition for which PLS–SEM is recommended.[43] Research into the investigation and implementation of mHealth apps is a relatively new field. Due to the exploratory nature of this investigation, it is advisable to employ PLS-SEM.

Findings

Validity and reliability

The validity and reliability analyses of the scales were carried out via the SmartPLS program. Factor loadings indicate the extent to which the statements are related to the

Table 1. Validity and reliability values of the measurement model.

Variables	Indicators	Outer Loadings	Indicator Reliability	Cronbach's Alpha ≥ 70	Composite Reliability (CR) ≥ 70	AVE ≥ 50
Digital Literacy (DL)	DL1	0.866	0.749	0.968	0.972	0.779
	DL2	0.908	0.825			
	DL3	0.908	0.825			
	DL4	0.908	0.825			
	DL5	0.867	0.752			
	DL6	0.863	0.745			
	DL7	0.908	0.825			
	DL8	0.857	0.735			
	DL9	0.897	0.805			
	DL10	0.841	0.708			
mHealth App Usability (MAUQ)	MAUQ1	0.903	0.815	0.985	0.986	0.796
	MAUQ2	0.890	0.793			
	MAUQ3	0.888	0.788			
	MAUQ4	0.880	0.774			
	MAUQ5	0.888	0.789			
	MAUQ6	0.902	0.814			
	MAUQ7	0.915	0.837			
	MAUQ8	0.889	0.790			
	MAUQ9	0.896	0.802			
	MAUQ10	0.903	0.815			
	MAUQ11	0.930	0.865			
	MAUQ12	0.918	0.843			
	MAUQ13	0.925	0.856			
	MAUQ14	0.926	0.857			
	MAUQ15	0.914	0.836			
	MAUQ16	0.867	0.752			
	MAUQ17	0.733	0.537			

(continued)

Table 1. Continued.

Variables	Indicators	Outer Loadings	Indicator Reliability	Cronbach's Alpha ≥ 70	Composite Reliability (CR) ≥ 70	AVE ≥ 50
	MAUQ18	0.872	0.760			
Patient Expertise (PE)	PE1	0.945	0.892	0.928	0.954	0.874
	PE2	0.939	0.882			
	PE3	0.920	0.847			

Table 2. Mean and discriminant validity results of the scales.

	DL	MAUQ	PE	Mean	S.D.
DL	**0883***			3.33	1.17
MAUQ	0.831	**0.892***		3.51	1.15
PE	0.790	0.912	**0.935***	3.43	1.22
RMStheta:0.119; **SRMR**:0.033; **Chi-Square**: 2519.564; **NFI**:0.911					

*$\sqrt{AVE}$.

factor. In addition, factor loadings determine the indicator reliability value. Indicator reliability values are obtained through taking the squares of the loadings. While factor loadings above 0.70 are preferred, indicator reliability values higher than the minimum level of 0.40 are considered acceptable. Cronbach's alpha coefficient and composite reliability value are the coefficients indicating the reliability of the model. The coefficients are considered suitable when they are 0.70 or above. Both coefficients meet the necessary conditions in the present study. The average variance extracted (AVE) values of the model are checked for convergent validity. Values of 0.50 and above indicate that the model has convergent validity (Table 1).[57–62] The values obtained within the scope of validity and reliability analyses are shown in Table 1. As shown in Table 1, the validity and reliability values are at an acceptable level. A reliability value of 0.70 and above indicates that the scales in the study meet the necessary conditions. The model has convergent validity (AVE ≥ 50). Based on these findings, it can be said that the model is reliable and meets the convergent validity criterion.

In the study, the validity of the model was assessed by considering the Fornell-Larcker criterion and the relationships among latent variables. According to the Fornell and Larcker[51] criterion, the square root of the AVE values of the latent variables in the model (given in boldface) should be higher than the correlation values in the rows and columns of the latent variables (Table 2). Table 2 shows the averages and discriminant validity results of the scales. As shown in Table 2, the diagonal values, representing the square roots of AVE in the model, exceed the correlation values of the other latent variables in the rows and columns. Thus, the model fulfills the discriminant validity criteria. Furthermore, the participants' mean perceptions of the scales range from medium to higher levels. This indicates that individuals exhibit digital literacy, mHealth app usability, and expertise.

Model fit measures in PLS-SEM. Standardized root mean square residual (SRMR) is the root mean square discrepancy between the observed and model-implied correlations. Because the SRMR is an absolute measure of fit, a zero value indicates a perfect fit. A value less than 0.08 is generally considered a good fit.[63]

Root mean square residual covariance (RMStheta) follows the same logic as SRMR but relies on covariances. RMStheta values below 0.12 indicate a well-fitting model, whereas higher values indicate a lack of fit.[63]

Non-fuzzy index (NFI) is developed by Roubens.[64] Its formula incorporates the a-posteriori probabilities of an observation belonging to a particular segment. Not to be confused with the normed fit index (also NFI) used in covariance-based structural equation modelling.[65]

As seen in Table 2, the SRMR value of the model was found to be 0.033. This value meets the criterion of being less than 0.08, cited in the literature. An NFI value higher than 0.90 indicates that the model has a good fit. For our model, this value was found to be 0.911. The RMStheta value was found to be 0.119, which is smaller than the reference value of 0.12. Based on these values, the model was determined to have a good fit.

Structural equation modelling (SEM)

The result output of the structural model obtained through the analysis performed using the Smart PLS program in accordance with the measurement model of the study is shown in Figure 2.

The details of the model, presented in the figure, are presented in Table 3, which also includes the findings regarding the results obtained in the model. According to the table, digital literacy has a positive and significant influence

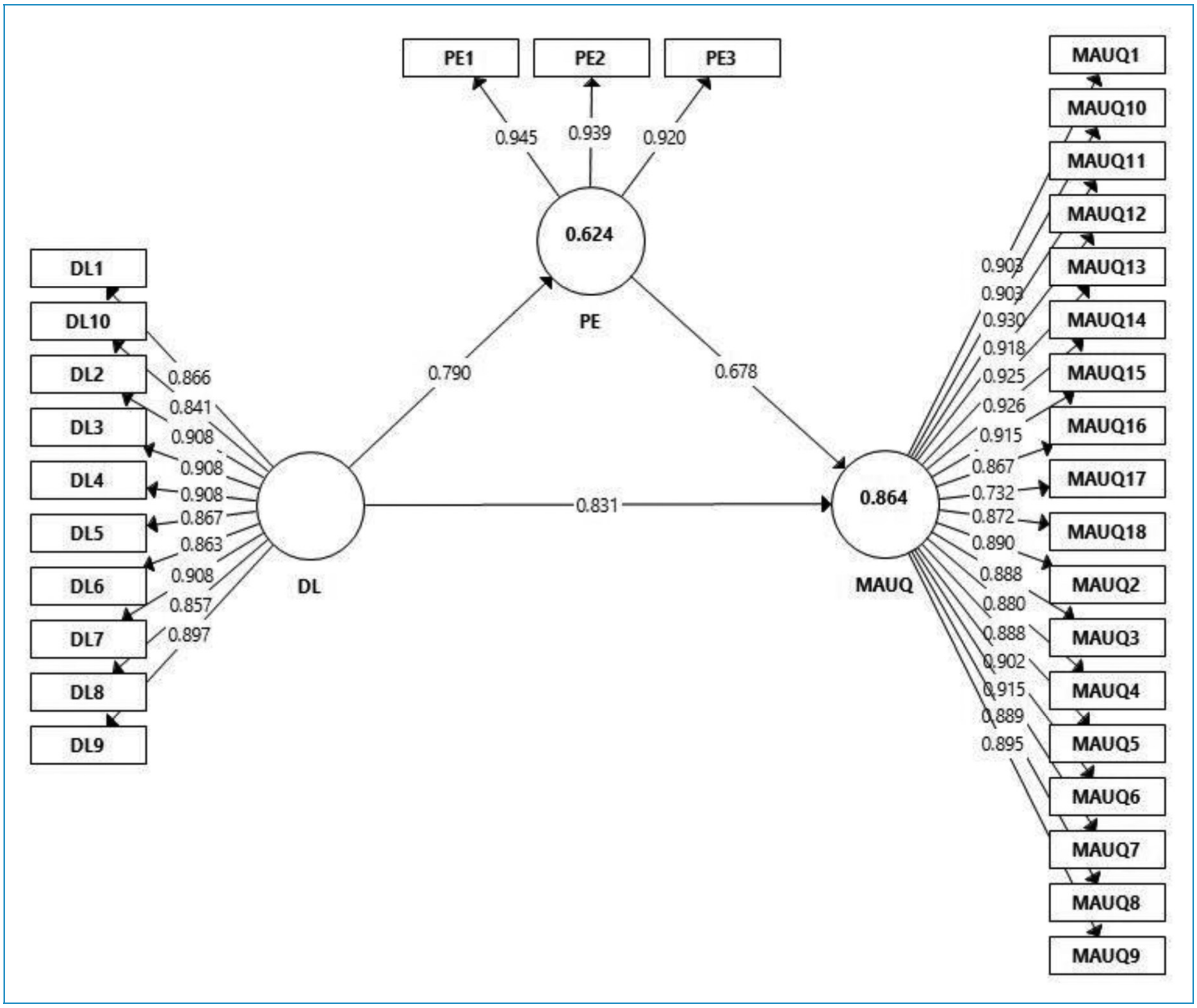

Figure 2. Model output.

Table 3. Β, t and *p* values obtained for the structural model test.

Paths Direct Effect	β	t Statistics	*p* Values	Decision
DL → MAUQ	0.831	46.020	0.000	H_1 Acceptance
DL → PE	0.790	35.560	0.000	H_2 Acceptance
PE → MAUQ	0.678	19.594	0.000	H_3 Acceptance
Indirect Effect	**β**	**t Statistics**	***p* Values**	**Decision**
DL → PE → MAUQ	0.536	17.477	0.000	H_4 Acceptance

on mHealth app usability (β = 0.831, t = 46.020, p = 0.000) and patient expertise (β = 0.790, t = 35.560, p = 0.000). Patient expertise has a positive and significant influence on mHealth app usability (β = 0.678, t = 19.594, p = 0.000). Moreover, patient expertise mediates the influence of digital literacy on mHealth app usability (β = 0.536, t = 17.477, p = 0.000). Given these findings, the hypotheses H_1, H_2, H_3, and H_4 are accepted.

Discussion

This study aimed to determine the mediating role of patient expertise in the influence of digital literacy on mHealth app usability. The results indicate that as individuals' digital literacy increases, so does their mHealth app usability. Considering these results, it can be stated that increased digital literacy levels of individuals may enable them to make better use of mHealth apps. Kaya & Eke[66] state that the benefit to be obtained from mHealth services is only possible with users' correct understanding of them; therefore, concepts such as digital literacy and health literacy play an important role in the effective use of mHealth apps. Many studies report that individuals who use mHealth apps are generally individuals with high health literacy.[67–70] Yeşildal[71] notes that there is a positive relationship between health literacy and digital literacy. In other words, digitally literate people are people who actively find information, analyze the information they find, discard the incorrect information and access the correct information, evaluate the correct information they have accessed, produce new information and present the information on digital platforms.[72] In this context, the importance of digital literacy is an undeniable fact in the health sector and is thought to be related to health literacy. Health literacy, which is indispensable in health service-related issues but is often overlooked, is the ability of people to understand information, actively use the advice given and benefit from the system in order to make the right decisions about their health.[73,74] Today, the existence of information searches through electronic resources reveals the existence of the digital aspect of health literacy.[75,76] With the increase in health-related applications and the use of the internet to obtain health information, the importance of individuals' digital literacy levels has emerged.[77,78] Based on the studies in the literature, it would not be wrong to say that digital literacy will help individuals better understand healthcare services and health-related issues and act more consciously on health-related issues. In this regard, given the studies in the literature and the results of the present study, it can be stated that it is quite usual for individuals with high levels of digital literacy to receive support from mHealth apps when they encounter health problems. It is clear that individuals' health literacy and health knowledge levels are interrelated.[79] In light of this information, as individuals' digital literacy increases, so does their knowledge about health apps, thereby enhancing the overall patient experience. The results of the present study indicate that as individuals' digital literacy increases, their experience with using mHealth apps also increases. In this context, the information in the literature and the results of the present study are consistent.

One of the key findings of the study is that individuals' digital literacy influences the use of mHealth apps, with mHealth app experiences playing a mediating role in this influence. In other words, the influence of individuals' digital literacy on the use of mHealth apps becomes much stronger when combined with their experience with mHealth apps.[80,81] Existing literature supports the notion that digital literacy is a crucial determinant of individuals' willingness and openness to utilize mHealth applications.[82] Specifically, the results suggest that digital literacy plays a crucial role in determining how effectively individuals can use mHealth apps, a conclusion that aligns with prior research emphasizing the importance of digital competency in navigating technology-driven healthcare services.[83–85] When the results of Lin & Lou's[86] study and the previously mentioned information and findings are evaluated together, it can be said that digital literacy and the use of mHealth apps positively support each other and that both of them increase continuously with the experiences gained. As a result, digital literacy is foundational to the successful adoption and sustained use of mHealth technologies. From this perspective, it is reasonable to say that the mediating role of patient experience is crucial. While digital literacy provides the general skills required to navigate digital environments, mHealth app expertise reflects more specific competencies related to familiarity with the features and functions of particular health apps. This expertise can develop through repeated usage and learning over time, allowing users to better tailor their app experience to meet their health needs.[87,88] Thus, mHealth app expertise not only mediates but also amplifies the effects of digital literacy, facilitating a more seamless and intuitive user experience.

Conclusion

The results obtained from the study show that individuals' digital literacy is an important antecedent in the use of mHealth apps. mHealth apps are used for post-care support, patient monitoring, disease and outbreak surveillance, emergency medical response systems, health information systems, mobile learning, behavior change, treatment adherence, diagnosis, disease management, and reporting.[69,89] In this context, increasing the frequency of individuals' use of mHealth apps is extremely important for health management and public health. Thus, the results of the present study suggest that the concept of digital literacy can be utilized to increase the use of mHealth apps by individuals. Accordingly, the organization of various training programs to increase the digital literacy level of society can lead to significant improvements in the use of mHealth apps.

Moreover, patient expertise plays a very important mediating role in the influence of digital literacy on mHealth app usability. The synergistic relationship between the concepts has a significant role in empowering patients and may increase the effectiveness of digital health interventions.

By recognizing the interconnected nature of these constructs and integrating insights from theoretical frameworks (e.g., TAM) and empirical research, healthcare stakeholders can develop more inclusive and effective strategies to promote digital health literacy and increase mHealth app usability among diverse user populations. Effectively addressing these factors requires the collaborative efforts of healthcare providers, developers, and policymakers to ensure that mHealth apps are accessible, usable, and beneficial for all individuals.

Recommendations

Understanding the complex relationships between digital literacy, mHealth app usability, and patient expertise has important implications for healthcare practitioners, developers, and policy makers. Healthcare providers should recognize the various levels of digital literacy and information-seeking behaviors among patients and adapt their communication strategies accordingly. For example, clinicians can assess patients' digital literacy levels and provide guidance and support on using mHealth tools effectively. In addition, healthcare organizations can offer training programs and resources to improve patients' digital literacy skills and promote self-management of health conditions through mHealth technologies.

mHealth app developers should prioritize user-centered design principles to increase the usability of mHealth apps by taking into account the changing expertise and preferences of the target user population. When developing mHealth apps, developers should also adopt methods aimed at enhancing digital literacy to improve the user experience and increase patient expertise. The above recommendations are grounded in adopting a user-centered approach that considers users' varying levels of digital literacy and patient expertise.

Limitations

This study has several limitations that need to be acknowledged. First, the research was conducted in a single city in Turkey, which may limit the generalizability of the results to the entire country. While the findings provide useful insights into the local population, they may not fully reflect regional differences in digital literacy, healthcare access, or mobile health (mHealth) app usage across the broader national context. Future studies conducted in multiple cities or across different regions of the country would provide more comprehensive data and help to increase generalizability.

Second, the cross-sectional design of the study limits our ability to infer causal relationships or explore long-term influences of digital literacy and patient expertise on mHealth app usability. To mitigate this limitation, we employed robust statistical analyses to control for potential confounding factors. However, longitudinal studies with repeated measures over time are needed to capture the dynamic and evolving nature of these constructs.

Moreover, individual motivations for using or avoiding mHealth apps, as well as variations in digital and health-related literacy, may differ substantially between healthy individuals and those with acute or chronic health conditions. To address this challenge, we carefully selected a diverse sample and controlled for basic demographic variables, yet we acknowledge that future studies should gather more detailed data on participants' general health status. This would allow for the detection of any differences between these populations and enable more targeted recommendations.

Additionally, we recognize that if users perceive an app as beneficial in the long term, they may be more tolerant of usability issues and more willing to invest time in learning how to navigate digital tools. To better understand this phenomenon, future research could integrate objective assessments of user engagement with mHealth apps over extended periods, combined with user feedback on perceived benefits.

Finally, while this study focused primarily on digital literacy and patient expertise, we recognize that contextual factors such as socioeconomic status and cultural background may significantly influence these relationships. Although efforts were made to include participants from diverse socioeconomic backgrounds, further research is required to explore these contextual influences in greater depth. Long-term studies could also examine the impact of interventions aimed at improving digital literacy on mHealth app usage and overall health outcomes.

Future research

Future research may use objective assessments and longitudinal designs to elucidate the dynamic nature of these constructs over time. There is a need for long-term studies examining the influence of interventions aimed at improving digital literacy on mHealth app participation and health outcomes. Additionally, further research is needed to explore how contextual factors such as socioeconomic status and cultural background influence the relationships between digital literacy, patient expertise, and mHealth app usability. All such future studies can provide valuable insights for the design and implementation of patient-centered care initiatives.

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