Jurnal Keperawatan Global
Vol. 9, No. 2, December 2024
https://doi.org/10.37341/jkg.v9i2.1015

Original Research

Validity and User Satisfaction of Educational Applications for Preventive Care of Diabetic Foot Wounds: A Study in Elderly Diabetes Sufferers

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ABSTRACT

***Background**: Education on using smartphone applications among the elderly to prevent diabetic foot wounds is still limited. Especially if someone pays attention to the limitations of older people with diabetes, such as their lack of mastery in using smartphones, an educational application for preventing diabetic foot wounds, named Rawat Kaki, has been developed by considering various aspects that make it easier for older people to use. This application must be tested for validity and evaluated to obtain an overview of the satisfaction of its users.*

***Methods:** The design of this study was exploratory quantitative to see the validity of the application and respondent satisfaction using the Rawat Kaki App. The sampling technique used purposive sampling with a total sample of 140 respondents from the population of Persadia (Indonesian Diabetes Association) members at the RSUD: Surakarta City, Sragen, Salatiga, Klaten Islamic Hospital, and PrambananSleman Yogyakarta Hospital. Five diabetes experts in the medical and nursing fields conduct content validity. Furthermore, respondents tested it three times to measure their satisfaction using the EUCS (End User Computing Satisfaction) questionnaire.*

***Results:** The content validity test obtained a value of 1.02 and an alpha Cronbach reliability value of 0.765, so the Rawat Kaki application was declared feasible. Then, the data is collected through a regression test, obtaining an R-value of 0.689, which means 68.9% of application user satisfaction can be explained through the Rawat Kaki application.*

***Conclusion:** The high validity and satisfaction of respondents might be a reason to consider using this educational application.*

ARTICLE HISTORY
Received: September 2nd, 2024
Accepted: December 20th, 2024

KEYWORDS
android app, diabetics, elderly, people with diabetes;

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Cite this as: Suyanto, S. ., & Lestari Dwi Astuti, S. (2024). Validity and User Satisfaction of Educational Applications for Preventive Care of Diabetic Foot Wounds: A Study in Elderly Diabetes Sufferers. *JKG (JURNAL KEPERAWATAN GLOBAL)*, *9*(2), 71–83. https://doi.org/10.37341/jkg.v9i2.1015

INTRODUCTION

Since information technology—smartphones—has grown in use, there has been an increasing number of applications related to diabetes mellitus (DM) treatment. This treatment is in line with the increasing number of older people with diabetes who need

attention. The physiological limitations of people with diabetes, such as impaired vision, reduced mobility, and cognitive challenges, make it difficult for this age group to access vital information and healthcare services, further hindering their ability to manage their condition effectively.

The existence of advances in communication and information technology in the form of smartphones has given the elderly the opportunity to access information and nursing services easily. It is known that 46.79% of elderly people in Indonesia have access to information and communication technology facilities, 14.10% have communicated using cell phones, and 14.10% have accessed the Internet. This makes it easier for seniors to connect with their families and access information on health issues.

With the latest information and communication technology facilities, applications for elderly health have developed in Indonesia. These applications, especially in elderly health, have been developed by the government, individuals, and educational institutions to accommodate these conditions (Augia, T., Dahlan, H., Symond, D., Siswati, S., & Dewi, 2022). In Indonesia, the number of educational applications for preventing diabetic foot wounds developed by the government or other institutions is unknown.

Various types of work for diabetes sufferers all have the potential to experience one hazardous complication, namely wounds on the diabetic foot. For example, respondents who work as farmers in Madura experienced this. In Madura, 72.4% of farmers are at moderate risk of developing diabetic foot injuries, and 11.8% of patients are at risk of experiencing severe foot injuries. Various types of work for diabetes sufferers all have the potential to experience one hazardous complication, namely wounds on the diabetic foot. For example, respondents who work as farmers in Madura experienced this.

In Madura, 72.4% of farmers are at moderate risk of developing diabetic foot injuries, and 11.8% of patients are at risk of experiencing severe foot injuries. Complications in the form of diabetic foot wounds can lead to amputation if not treated properly. Before complications occur, taking steps to prevent foot injuries is necessary. This complication can be done, among other things, by providing education to every diabetic sufferer because they are at risk of developing diabetic foot wounds. Therefore, farmers with diabetes need intensive attention from medical personnel to provide education about the importance of foot protection while working (Rofiqi, M., Sutawardana, J. H., & Kushariadi, 2024).

Diabetes is the most common cause of non-traumatic amputation worldwide, and education is critical to prevention. Likewise, healthcare providers must develop nursing services using information technology to minimize direct clinic visits. This condition makes us realise that we must develop services and health education changes for diabetic patients to align with the 4.0 era. We need to be concerned about this condition because diabetes patients are known to have a high risk of developing foot injuries (Miranda, C., Zanette, G., & Da Ros, 2022). For this reason, researchers and developers have created a variety of information technology-based health education tools and platforms.

Smartphone applications like Android-based make it easier for people with diabetes to access diabetes counselling and home care services. However, developers need to address several weaknesses and deficiencies in the use of applications (Santoso, B. J., Qona'ah, A., & Frety, 2022). Obstacles to using smartphones when conducting education have been identified and resolved. It is also a fact that the application

developed must be more specific and centered on one specific problem, not too general or broad. For example, developers must create Android-based applications to improve foot care behavior by educating users about proper foot care (Cheng, Y. J., Masingboon, K., Samartkit, N., & Moungkum, 2023).

However, the developed application must be improved and tested before being operationalised as a smartphone application for diabetic foot risk reduction (Kilinc, M., & Karadağ, 2020). Even more so when a person with diabetes suffers, remember that various types of tools and operating system platforms underlie applications. Many educational applications use the Android Operating System (AOS) as a platform. This operating system has many advantages and is easy to operate. It is considered more cost-effective, and its users are extensive in society (Mehraeen, E., Mehrtak, M., Janfaza, N., Karimi, A., Heydari, M., Mirzapour, P., & Mehranfar, 2022).

Older people with limited reach and mobility can use smartphones as a learning medium to access anytime. The research results state that smartphones are an alternative medium everyone can use to convey the necessary information without time or place restrictions. This method also simplifies activities to quickly access information anytime and anywhere (Sugandi, M., & Halim, 2020). The development of information technology in the Industrial Era 4.0 requires the development of nursing services to adjust to the changing landscape. The research aims to develop validated educational applications that provide satisfaction to elderly users so that cell phones, such as smartphones, a means of nursing education services, can be easily accessed anytime and anywhere and can be repeated.

MATERIAL AND METHOD

This research used an exploratory quantitative design to develop and validate the foot care educational application. We base data collection on application user satisfaction as measured by the End User Computing Satisfaction (EUCS) Questionnaire. The aspects measured include content, accuracy, format, ease of use, and timeliness. Patients with type 2 diabetes as a population are members of Persadia (Indonesian Diabetes Association) at Fatmawati Sukarno Hospital, Surakarta City; Klaten Islamic Hospital; Sragen Regency Hospital; Salatiga City Hospital; and Sleman Regency Hospital, Yogyakarta, as many as 980 people. We used purposive sampling to select samples and calculated the sample size using the Slovin formula with a 95% confidence level. We obtained a sample of 140 participants who did not have foot ulcers.

The programming languages used are JavaScript, TML5, PHP, and MySQL database. We named the application Rawat Kaki and hosted it on the Play Store service. Based on the research results, recommended features in the diabetes application are daily foot care and prevention of foot wounds (Ogrin, R., Viswanathan, R., Aylen, T., Wallace, F., Scott, J., & Kumar, 2018). So this application's features include patient data, a questionnaire containing instructions on how to care for feet, and learning to care for feet in the form of pictures and videos. A reminder feature reminds patients to take care of their feet daily. Using reminder applications regularly reminds patients and helps with self-care at home (Gusdiani, I., 2021).

Several stages are needed for good application design and validity (Nabovati, E., Rangraz Jeddi, F., Tabatabaeizadeh, S. M., Hamidi, R., & Sharif, 2022). The research used five stages: First, determining the content reviewed based on clinical practice guidelines. Second, information technology experts designed and developed the

application using Java. Third, the content validity index test should involve at least three experts but not more than ten people (Polit, D. F., Beck, C. T., & Owen, 2007). Therefore, this research involved five experts. Consisting of two internal medicine specialists and three diabetes exceptional education nurses from Indonesia.

Fourth, testing was carried out on respondents, starting with explaining the Rawat Kaki educational application. When using the application for the first time, respondents were explained how to download it on Playstore and then asked to fill in their biodata. Next, the respondent can try to start using the application, such as filling out a questionnaire about the condition of the foot care that the respondent is currently doing, and a score will appear about whether the foot care that the respondent has done is good or bad.

After knowing the score, respondents can start learning to care for their feet, starting by watching videos on how to care for their feet, reading foot care booklets, and watching videos of foot exercises. Next, learn to check foot sensitivity using videos and read tips on how to prevent foot injuries. Also available in this application are reminders to carry out foot care every day. So that respondents can use the application well, they are given assistance on how to use the application at least three times within two weeks.

All respondent activities when accessing the application were recorded via Google Forms in the form of a spreadsheet. Fifth, respondent satisfaction data was collected using the End User Computing Satisfaction (EUCS) instrument, which has been used significantly in the last ten years (Doll, W. J., & Torkzadeh, 1988). The results of validity and reliability tests in a study using EUCS stated that all indicators were declared valid and reliable with an AVE value > 0.50 in validity testing and a composite reliability value > 0.70 in reliability testing (Aprilia, S, Samsuryadi., 2021).

The data collected in Linkert form consists of Very Satisfied (4), Satisfied (3), Dissatisfied (2), and Very Dissatisfied (1). For the validity test, the value of r = 0.034, and for the reliability test, Cronbach's alpha value = 0.765. Whereas the Content Index Validity test value (CVI) = 1.02. The Health Research Ethics Commission of Muwardi Hospital Surakarta issued the research ethical feasibility permit on April 28, 2024, with the number 903/IV/HREC/2024.

RESULTS

The following is a display of the front page (Figure 1) and feature pages of the foot care educational application (Figure 2).

Figure 1. Display of the front page

Figure 2. Feature pages of the foot care educational application

Next, the results of the content validity test of *the Rawat at Kaki* application conducted by five diabetes experts in the medical and nursing fields are shown below:

Table 1. Distribution of Content Validity Proportion of *Rawat Kaki* Application

Aspect EUCS	Proportions					Mean i-CVI
	R1	R2	R3	R4	R5	
Contain	1	1	1	0,75	1	0,99
Accuracy	1	0,75	1	1	1	1
Format	0,75	1	0,75	1	0,5	0,8
Easyof Use	0,75	1	0,75	0,5	1	0,8
Timeliness	1	1	1	1	1	1
S-CVI 1,02						

To see how satisfied respondents are using the *Rawat Kaki* education application, it can be seen in Table 2 below.

Table 2. Distribution of Respondent Satisfaction Based on EUCS Aspects

Satisfaction level	Aspect EUCS									
	Content		Accuracy		Format		Ease of use		Timeliness	
	n	%	n	%	n	%	n	%	n	%
Very dissastified	2	1,5	2	1,4	40	28,5	15	10,7	5	3,6
Dissatisfies	5	3,5	5	3,6	6	4,4	55	39,3	15	10,7
Satisfied	103	73,5	105	75	80	57,1	50	35,7	100	71,4
Very satisfied	30	21,5	28	20	14	10	20	14,3	20	14,3

Table 2 shows that the distribution of respondents' satisfaction with the content aspect obtained the most satisfied data. We can see the same in accuracy, format, and timeliness. As for the ease of use aspect, the respondents who were dissatisfied and satisfied were almost the same. Table 3 below presents the results of the correlation test of respondents' satisfaction with using the *Rawat Kaki* application as follows:

Table 3. Distribution of Respondent Satisfaction Correlations on EUCS aspects

Aspect EUCS	Coefficient				sig
	B	Std Error	Beta	t	
Contain	,083	,024	,278	3,478	,001
Accuracy	,100	,047	,173	2,101	,037
Format	,053	,036	,138	1,503	,135
Easeof Use	,044	,032	,119	1,367	,174
Timeliness	,133	,044	,239	3,001	,003

The analysis results of the correlation test obtained a correlation value between aspects of content, accuracy, and timeliness in EUCS and the elderly respondents' satisfaction when using the Rawat Kaki application. While the aspects of format and ease of use are not related, they get a value of 0.135 and 0.174 each, which means > 0.05. This data indicates that it is necessary to review application features in terms of format and ease of use of display. Similarly, we need to review the application of use by describing each feature in various ways. These are the results of the regression test analysis of patient satisfaction using the *Rawat Kak*i application.

Table 4. Correlation and Regression Analysis of EUCS Aspects and Respondent Satisfaction

Variable	r	R Square	p. value
Satisfaction	0,830	0,689	0,000

The correlation and regression analysis results strongly correlate with EUCS aspects and respondents' satisfaction with the Rawat Kaki application. It also shows that as many as 68.9% of respondents can explain their satisfaction with using the Rawat Kaki application. The correlation is also very significant (p. value = 0.000 < 0.005).

DISCUSSION

Researchers have studied the need for education through information technology-based applications as a new way to change the knowledge, attitudes, and behaviour of DM patients. So many smartphones and other applications have been created and used to educate diabetes patients (Wardoyo, N. B., & Kusumo, 2023). So many smartphones and other applications have been created and used to educate diabetes patients.

Developers have even created an app to address amputation risks and promote self-care practices to prevent serious foot complications. Many smartphones and other applications are created and used for education, even applications about amputation risks and self-care practices to prevent serious foot complications. The content uses simple images and words, focusing on early help-seeking behaviors (Ogrin, R., Viswanathan, R., Aylen, T., Wallace, F., Scott, J., & Kumar, 2018).

We also know that smartphone applications can potentially improve diabetes care. However, there is still no evidence of sustainability, so the impact of using the 1,100 applications available worldwide for diabetes care is unknown (Garabedian, L. F., Ross-Degnan, D., & Wharam, 2015). Until now, interest in developing smartphone-based health applications for treating people with diabetes continues to increase. This happens because it can be a promising new treatment modality. Other research also proves that respondents with an average age of 44 years found that most respondents experienced positive changes in their clinical course after using the application.

They also felt satisfied with the application and its completeness and would continue to use it to manage their diabetes. The results of this study indicate that the elderly respondents were satisfied with using the Rawat Kaki App. This is because the elderly are very concerned about health problems; they obtain health information from information technology such as smartphones and their applications. Several studies have shown that the elderly need access to health information, mainly through smartphone social media applications (Damayanti, K. A., & Hariandja, 2015). .

Most existing applications are only for detecting the risk of foot wounds rather than for preventing foot wounds. As has been researched, the most common serious complication in people with diabetes is diabetic foot ulcers due to delays in early identification by patients. This condition requires a breakdown to enable self-detection anytime and anywhere using one of the applications. However, it is necessary to investigate further the usefulness and effectiveness of mobile applications on patient behaviour in preventing foot ulcers with long-term follow-up (Agustini, N. L. P. I. B., Suniyadewi, N. W., Rismayanti, I. D. A., Faridah, V. N., Utami, R., Aris, A., & Nursalam, 2022).

Therefore, it can be understood that this research obtained the most satisfaction from respondents compared to dissatisfied and very dissatisfied respondents, except in terms of format and ease of use. The usage gap can explain the limitations of the elderly in cognition and vision and the ability to use smartphones. Therefore, several smartphone applications that have been developed need to be analyzed to determine the minimum features for diabetes applications (Salar, R., R Niakan Kalhori, S., GhaziSaeedi, M., Jeddi, M., Nazari, M., & Fatehi, 2021). This research also obtained the result that there is a strong correlation of satisfaction with the application's content. This indicates that the application's content is highly desirable for the elderly because it provides health information, especially the prevention of diabetic wounds.

Therefore, it can be understood that this research obtained the result that there is a robust correlation between satisfaction with five aspects of the application (p-value

0.000 < 0.05). The educational application appears very satisfying for the elderly, so the Rawat Kaki educational application can be used and developed again by paying attention to the lacking aspects of format and ease of use. It is expected that later, smartphone applications that offer great potential to support therapy management, improve therapy adherence, and prevent disease complications will continue to be pursued by paying attention to the features of mobile applications that are easy to use and capable of providing specific instructions (Izahar, S., Lean, Q. Y., Hameed, M. A., Murugiah, M. K., Patel, R. P., Al-Worafi, Y. M., ... & Ming, 2017).

The Rawat Kaki App in this research, based on a mobile system, can be developed using the cloud to make it more extensive, cheap, and flexible. Research shows that the use of mobile and cloud-based systems can be fulfilling and promising but requires further research with long-term follow-up (Salari, R., R Niakan Kalhori, S., GhaziSaeedi, M., Jeddi, M., Nazari, M., & Fatehi, 2021). Most elderly diabetics will experience difficulties using smartphone applications, as a study found several disadvantages of smartphones when used in the service of elderly diabetics.

Other researchers revealed that the available applications had to serve the unique needs of diabetic patients aged 50 years or more by conducting an expert usability evaluation (Arnhold, M., Quade, M., & Kirch, 2014). This is aimed at avoiding the possibility that the application is owned by their smartphones but rarely used. It is also explained that the functions of the existing applications often need help to fulfill the preferences of those over 56 years old (Wahyudi. C.T., 2019). Applications are expected to be tools for positive change because they can help clarify the information delivered with a more attractive and easy-to-operate display and involve the five senses. Research on the intention to do Rawat Kaki for the prevention of diabetic foot wounds found that the digital media contributed positively to increasing respondents' knowledge of preventing foot wounds (Susilawati, E. Lestari, Y.P. Nurrika, 2024).

In addition, in developing applications, it is very necessary to pay attention to the usability aspect. Hence, the users are easy to operate and provide benefits and satisfaction, especially for the elderly. For this reason, when developing the optimal feature design for elderly users, it is important to use images (Alsana., 2021). This has also been found in another research study, where the application must be friendly, the text must be bold, and large fonts must be used so that it is easy to read and can be easily understood (Sebastian, D., & Hawini, 2022). Thus, each application must be continuously evaluated and developed. It can be redesigned to make it easier to use, especially for elderly users (Duma Konda, V. W., Restyandito, R., & Nugraha, 2022).

It suggests that in order for the application to be used by the elderly, who are increasing in number of users, it is necessary to pay attention to several aspects, namely instructions on how to start using the application and the use of clear icons and buttons in the form of images or text (Wahyudi. C.T., 2019). The results of other research (not on the elderly) found that teenagers increased the receiving of knowledge about reproductive health by using Android applications because they are interesting, easy to operate, and involve many senses. However, it needs to be developed by adding pictures, animations, or videos to be more interesting (Dinengsih, S., & Hakim, 2020), (Yustin, E., Wijanarka, A., & Ashari, 2020).

The data obtained in this research shows that the respondents' education level is at least elementary school, and some respondents have a higher education. This affects the flow of research because the use of smartphone applications is influenced by educational level factors related to knowledge about foot care at risk of diabetic foot

wounds. The higher the level of education, the better the knowledge (Dincer, B., & Bahcecik, 2021). Another research revealed that an application was tested on nursing students as respondents to observe usability, with the results that the content and appearance of the application were considered the most important to be adequate so that the application is easy to use. Thus, educational research using applications to prevent hypoglycemia showed that the application-based diabetes education model on smartphones was feasible for detecting hypoglycemia (Damayantie, N., Ernawati, E., Dewi, M., & Fahmi, 2024).

Results of the research after regression testing found that the Rawat Kaki application has high content validity and a robust correlation with respondent satisfaction, even though some aspects are lacking, such as features and ease of use. So, considering that applications on smartphones already play an important role in complementing diabetes care, in order to be well received by users, the content and context of the problem should be regulated, and more customized behavior to the needs of users with clear guidance (Huang, Z., Soljak, M., Boehm, B. O., & Car, 2018). For example, the Rawat Kaki App with videos has been proven effective in increasing individuals' knowledge, self-efficacy, and behaviour concerning foot care (Dincer, B., & Bahcecik, 2021).

For this reason, in this research, the application content in the feature is combined with the booklet included in the application, considering that booklets also greatly influence education. It has been researched that smartphones with contextual learning models are more effective in improving self-care than education using booklets; however, both types of education can improve self-care in people with diabetes (Santoso, B. J., Qona'ah, A., & Frety, 2022). After this, healthcare solutions can be assisted using smartphone applications that provide personalised healthcare services, such as emergency calls and messages in real-time, crucial moments, and GPS reporting technology (Khan, F. A., & Khan, 2016).

The limitation of this research needs attention. Even though the application has been successful in helping people with diabetes, it found that it has limitations, such as limited use within a certain period, so it is necessary to review which aspects support and interfere with the use of the application (Ogrin, R., Viswanathan, R., Aylen, T., Wallace, F., Scott, J., & Kumar, 2018). The sample proportions based on gender, education level, occupation, and age were not determined.

Limitations also exist in the application features, which are one-way communication rather than two-way interaction. As a solution, further development is possible, such as developing two-way online-based education so that there is interaction between patients, families, and health workers, as carried out in research that produced an online application-based educational prototype called Telemondia (Isworo, A., Ramadhani, Y., Anam, A., Ekowati, W., & Azalia, 2021).

CONCLUSION

The research indicates that the Rawat Kaki App has a high validity test value. After being utilised by elderly respondents, it has a high level of satisfaction. Then, regression testing to determine that the application has a good model, which is 68.9% of the application, can explain patient satisfaction with using the Rawat Kaki application.

To be accepted into the model, it is recommended that the aspects of ease of use and format be improved. Two-way developing communication features must also be more interactive with users.

ACKNOWLEDGEMENTS

Thanks to the head of the Poltekes Surakarta for allowing researchers to conduct this research for Persadia administrators at RS Islam Klaten, RSUD Prambanan, RSUD Sragen, RSUD Surakarta, and RSUD Salatiga.

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