ORIGINAL ARTICLE

# E-FRIDEM Learnability as Type 2 Diabetes Mellitus Screening Tools In Indonesia

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## ABSTRACT

**Introduction:** Implementing nursing through online media could be an alternative for carrying out the nurse's role in type 2 diabetes prevention. Technological developments encourage nurses to be more creative in their care delivery. However, based on previous studies in Indonesia, there is no android-based screening accessible to health providers and the general people. e-FRIDEM (Faktor Risiko Diabetes Mellitus) is an android-based type 2 Diabetes Mellitus developed by researchers based on ADA (American Diabetes Association) screening and FINDRISC (Finnish Diabetes Risk Score) adapted to the characteristics of the Indonesian people. This study aimed to identify the learnability e-FRIDEM as type 2 Diabetes Mellitus screening. **Methods:** This study is a quantitative study using a cross-sectional design. This research involved 40 adults who lived in West Java, Indonesia. The SUS (System Usability Scale) questionnaire was used in this study to assess users' learnability while using e-FRIDEM. The data analysis in this study used descriptive analysis, which was preceded by a Shapiro-Wilk normality test. **Results:** The results of this study include a summary of the respondents' demographic characteristics. Most of the respondents are 45-54 years old and have the lowest learnability value (78.46±13.092). Furthermore, this group has the highest proportion of respondents with average learnability above average compared to other age groups. The average learnability of all respondents is 80.38, with a 95 % Confidence Interval (CI) of 77.07-83.68. Respondents' time spent filling out e-FRIDEM varies by age group. The amount of time required for respondents to complete applications tends to increase with age. In the second trial, respondents aged >65 years required an average of 8.6 minutes. The mean time difference between the first and second trials was most significant in the 55-64 years age group, ranging from 7.3 to 6.5 minutes. **Conclusion:** This study concludes that the learnability of e-FRIDEM is more than the set average. This result indicates that e-FRIDEM can be used as a screening tool for Type 2 Diabetes Mellitus in Indonesia. According to these findings, nurses as health care providers can use e-FRIDEM as a preventive measure for Type 2 Diabetes Mellitus.

**Keywords:** FRIDEM, Type_2_DM, Risk_Factor, Screening_Tools

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## INTRODUCTION

Diabetes Mellitus (DM) is a public health issue that is one of the four major non-communicable diseases globally. The number of cases and prevalence of diabetes has continued to increase over the previous few decades (1). Diabetes mellitus is a metabolic disease characterized by hyperglycemia due to insufficient insulin secretion, action, or both (2,3). Diabetic-related with chronic hyperglycemia showed long-term impairment, dysfunction, and failure of various organs body, including the eyes, kidneys, nerves, heart, and blood vessels (4). IDF (International Diabetes Federation) stated that it is expected that in 2030 the number of people with DM will continue to rise each year (5). Likewise, the incidence of DM in Indonesia continues to increase.

The prevalence of DM in Indonesia is 8.4 million and is expected to be 21.3 million in 2034.

Blood sugar levels that exceed the standard range increase the risk of dying and the chance of developing cardiovascular and other diseases5. 43% of the 3.7 million deaths occur before 70 years and cause amputation, disability, and death (1). DM also has the effect of reducing life expectancy by 5-10 years(6). This condition is related to the risk factors for diabetes, such as a fast-paced lifestyle, poor food, and insufficient physical activity. According to the Ministry of Health of Indonesia, understanding the risk factors of DM is the prevention of it. There are two types of risk variables: those that can be altered and those that cannot. Changes in lifestyle, sleep habits, physical activity, and physical activity stress management are all possible.

Age and genetics are unchangeable factors. Diabetes mellitus, particularly type 2 diabetes, can harm the quality of human resources and increase health care expenses. As a result, the necessity of a preventative effort coupled with the deployment of early detection of DM cannot be overstated. Several methods for early detection of diabetes mellitus have been developed, including screening institutes from the ADA (American of Health). Diabetes Association risk test and FINDRISC (Finnish Diabetes Risk Score) have been translated into other languages, including Indian, Spanish, and Indonesian. The score for early detection is critical to identify the risks and causes of diabetes mellitus from a health perspective within the community, as this may suggest a need within the community group. Specific communities' risk scores may not apply to other ethnic groups. As a result, it is necessary to develop a diabetes risk score for the Indonesian population. Besides that, the majority tools were developed for white populations, with only a few for Asian populations (7–10). Additionally, having their score may drive individuals to apply the procedure (10).

Nursing services delivered via online media may also be a viable option for nurses to fulfill their role in DM preventive efforts during the COVID-19 pandemic, such as: at present. The COVID-19 preventative health guideline pushes nurses to be more creative in their care delivery. Additionally, numerous studies have been undertaken to assess the community's self-awareness of the risk factors for diabetes mellitus. However, available research indicates that there is no screening that can be accessed everywhere by both health care providers and the general public. In this study, researchers interested in developing an Android application based on FRIDEM (Faktor Risiko Diabetes Mellitus), a screening tool for type 2 diabetes developed by researchers based on ADA Risk and FINDRISC, which has been adapted to the Indonesian people's characteristics (in the process of publication).

Usability is a subfield of the vast field of Human-Computer Interaction (HCI). Human-Computer Interaction is a research topic that has grown since 1970 and focuses on constructing a user-friendly computer screen display for an information system application. Measuring usability entails determining the efficacy, efficiency, and satisfaction of the system (usability economy). A component of usability, learnability, quantifies the ease of completing simple tasks when you first encounter a design (11,12). This study will examine the learnability of using e-FRIDEM as a screening tool for an android-based type 2 diabetes mellitus.

## MATERIALS AND METHODS

### Research design and sample

Cross-sectional data collection was conducted on 40 individuals who agreed to participate in this study as respondents. The total sample size is based on sample calculations using G*Power Software version 3.1.9.4 with effect size 0.3 and power size 0.95. Accidental sampling was employed as the sampling technique. The inclusion criteria for this study were adult residents of Bandung, West Java, who agreed to participate as respondents.

### Instrument

We assessed e-learnability FRIDEM's using a standardized usability questionnaire. The questionnaire utilized is the System Usability Scale (SUS), which comprises ten components (12). Learnability is frequently equated with usability (13). Learnability quantifies the ease with which simple tasks can be completed when confronted with a design for the first time. While the two ideas are related, learnability is distinct. The term learnability has two meanings. One refers to the user interface's ability to execute tasks on the first attempt, frequently referred to as usability for first-time use (13,14). Learnability is also considered to be a component of usability. The System Usability Scale (SUS) was employed in this study, consisting of ten items (15).

The System Usability Scale (SUS) is a simple, dependable method for assessing usability. It is a ten-item quiz with five response options ranging from Strongly Agree to disagree for respondents Strongly. It was founded in 1986 by John Brooke and enabled you to review a broad range of items and services, including hardware, software, mobile devices, websites, and applications. The predicted score for questions with an odd number is 5 (Strongly Agree), while the unexpected score is 1 (Strongly Disagree). For questions with an even number, the expected score is 1 (Strongly Disagree), while the surprising score is 5 (Strongly Disagree) (Strongly Agree)(16).

Scoring can be challenging to interpret. The participant's scores on each question are translated to a new

number, summed together, and then multiplied by 2.5 to convert the participant's original 0-40 scores to 0-100. While the scores range from 0 to 100, they are not percentages and should be interpreted according to their percentile rank.

**Table I : System Usability Scale (SUS)**

| Number | Question |
|---|---|
| 1 | I think I will use this system again |
| 2 | I find this system complicated to use |
| 3 | I find the system easy to use |
| 4 | I need help from other people or technicians in using this system |
| 5 | I feel the features- this system features work properly |
| 6 | I feel there are a lot of things that are inconsistent (incompatible with this system) |
| 7 | I feel others will understand how to use the system quickly |
| 8 | I find the system confusing |
| 9 | I feel there are no obstacles in using the system the |
| 10 | I need to familiarize myself first before using this system |

According to studies, a SUS score greater than 68 is considered above average, while anything less than 68 is considered below average; nevertheless, the most objective approach to evaluating your results is to "normalize" the scores to generate a percentile rating.

Additionally, this study used e-FRIDEM, an electronic screening tool based on an Android platform, to assess the risk of incident type 2 diabetes mellitus that arose as a result of ADA and FINDRISC screening (FRIDEM development process is currently in the publication stage).

**e-FRIDEM Features**

e-FRIDEM is an android-based diabetes mellitus type 2 screening tool that includes several menus such as user profiles, charts, diabetes-related health education, and the FRIDEM screening menu. The latest information on education menu is supposed to improve user literacy regarding diabetes mellitus and its prevention. Additionally, the user may conduct multiple screenings, which will be recorded on the menu chart. After completing the screening, each user will receive a summary of their risk score, which is categorized as mild, moderate, or severe. Along with a recapitulation of the user's scores and risk categories, the user gets several recommendations for preventing DM Type 2 that have been adjusted to the user's screening results.

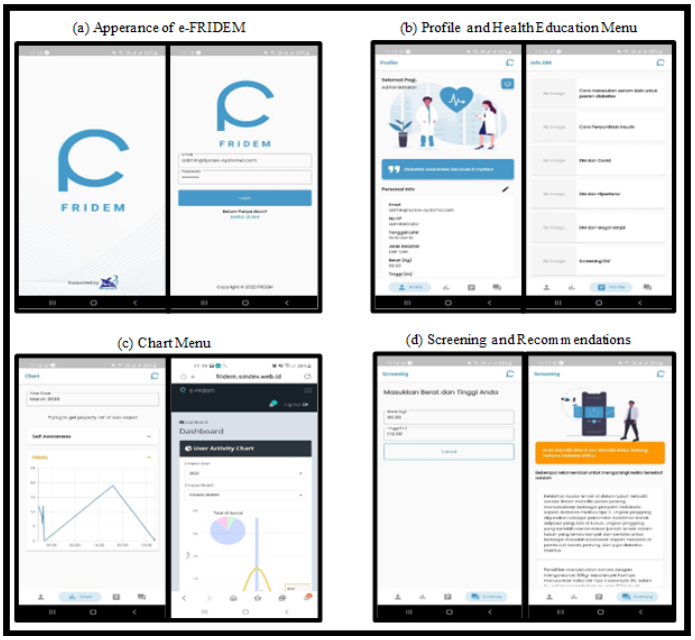



**Figure 1 :** e-FRIDEM Features

**Table II : Screening Items FINDRISC, ADA Risk Test, and FRIDEM**

| No | FINDRISC | ADA RISK TEST | FRIDEM |
|---|---|---|---|
| 1 | Age | Age | Age |
| 2 | Family | History Family History | Gender |
| 3 | Upper Arm Circumference | Gender | History Gestational Diabetes |
| 4 | BMI | BMI | Family History with Diabetes |
| 5 | Daily Activities day | Activities day-to-day | history of hypertension |
| 6 | Diet Vegetarian | History of Gestational Diabetes | daily activities |
| 7 | History of hypertension | History of hypertension was | BMI |
| 8 | History Hyperglikemia | | Waist |
| 9 | | | consumption of vegetables and fruits |
| 10 | | | History of high blood sugar |

The process of collecting data in the study was carried out directly by distributing questionnaires and observing the rate at which they were completed filling out the tools. Previously, respondents were gathered during health education activities aimed at preventing chronic disease. Furthermore, respondents were measured for blood pressure, anthropometry (weight, height, and waist circumference), and blood sugar levels. Following that, all respondents started the DM Type 2 screening using e-FRIDEM on their mobile phones. The researcher timed the process of filling out the instrument and provided a questionnaire for the respondent to complete. This research have got ethical clearance by the ethics committee of STIKep PPNI Jabar with the number III/006/KEPK-SLE/STIKEP/PPNI/JABAR/II/2022.

**Data analysis**

The data analysis was carried out in stages, beginning with univariate analyses and multivariate analyses using the SPSS version 22.0 program. The learnability of e-FRIDEM is described using descriptive statistics. Before doing the bivariate statistical test, the data were check for normality using Shapiro Wilk (n<50). The data analysis results were normally distributed with a p>0.05.

**RESULTS**

The findings of this study summarize the respondents' demographic features, the majority of whom are aged 45-54 years and have the lowest learnability value (78.46±13.092). Additionally, this group has the highest proportion of responders with average learnability above average compared to other age groups. Meanwhile, responders aged 35 years or older demonstrated the highest learnability value. Additionally, most responders are female, with a higher learnability score than males (80.42±5.863) (Table III).

Table IV summarizes the learnability of e-FRIDEM as determined by SUS. The average learnability of all respondents is 80.38, with a 95 percent confidence interval (CI) of 77.07-83.68. These findings indicate that the average of all responses is greater than the average (68).

**Table III : Learnability Score based on respondent characteristics (n=40)**

| Characteristic | n | % | Learnability | | |
|---|---|---|---|---|---|
| | | | (1) | (2) | (mean±SD) |
| Age (yo) | | | | | |
| <35 | 7 | 17.5 | 6 | 1 | 82.14±12.368 |
| 35-44 | 6 | 15.0 | 6 | 0 | 81.67±9.037 |
| 45-54 | 13 | 32.5 | 10 | 3 | 78.46±13.092 |
| 55-64 | 8 | 20.0 | 7 | 1 | 80.31±8.705 |
| ≥65 | 6 | 15.0 | 6 | 0 | 81.25±5.863 |
| Gender | | | | | |
| Woman | 30 | 75.0 | 26 | 4 | 80.42±10.362 |
| Man | 10 | 25.0 | 9 | 1 | 80.25±10.830 |

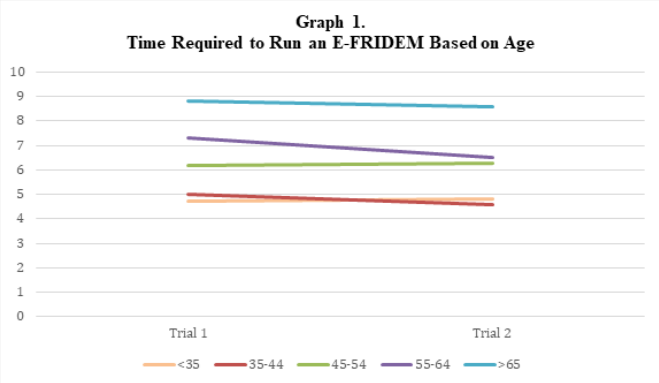
*(1) Learnability above average; (2) Learnability below average; learnability average: 68

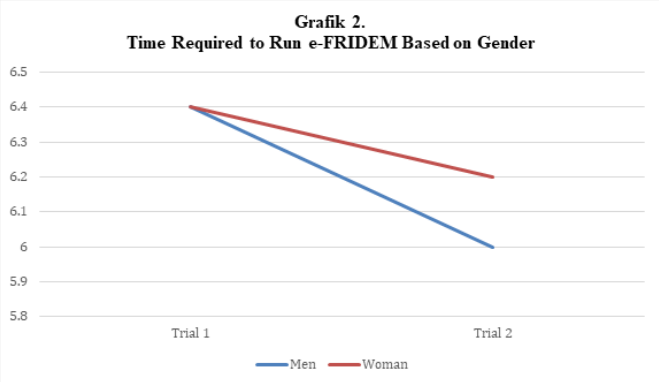
**Table IV : E-FRIDEM Learnability using SUS (n=65)**

| Variable | Mean | Median | SD | Min-Max | 95% CI |
|---|---|---|---|---|---|
| Learnability | 80.38 | 80.00 | 10.340 | 58-100 | 77.07-83.68 |

Respondents were required to complete the application form twice. Graph 1 depicts the average time taken by respondents to complete e-FRIDEM by age group. The amount of time needed for respondents to complete applications tends to increase with age. In the second trial, responders aged >65 years required an average of 8.6 minutes. The mean time difference between the first and second experiments was most remarkable in the 55-64 year age group, ranging from 7.3 to 6.5 minutes.

The average time required to complete the e-FRIDEM in the first experiment was 6.4 minutes for male and female responders. Male respondents took less time than female respondents in the second experiment (Graph 2.).




## DISCUSSION

This study demonstrates that respondents of all ages had a high level of learnability on average. As previously stated, along with efficiency, memorability, mistakes, and satisfaction, learnability is one of the five quality components of usability (17). Learnability testing is highly beneficial for complicated programs, and systems users access regularly, yet it is also helpful for objectively simple systems. In other words, learnability considers how simple it is for users to do a job the first time they encounter an interface and how many repetitions it takes for them to become proficient at that task.

In testing, the measured time determines how quickly the user completes the tasks being evaluated. Naturally, a task should not take an excessive amount of time. Additionally, customer pleasure will suffer if the time required to do tiny actions within the application is outrageous. An application should be developed in such a way that it makes work easier and faster. Usability testing revealed that numerous factors such as experience, learning speed, and participant effort influenced the average and variation of each task. Additionally, by utilizing the instrument (SUS), the application's fault cannot be determined.

This usability test yielded an overall SUS rating of 80.38. This is a relatively high value in comparison to the average SUS score of 68. Compared to the SUS value for mobile device products, e-SUS FRIDEM's value is also higher than the industry average of 64.7. This demonstrates that the system's condition while testing is consistent with the application's overall performance. After analyzing the experiences of all participants, the scores obtained represent the user's ease with which the specified activities are completed. This is consistent with several studies that have been conducted on the use of android- and web-based applications in the treatment of Type 2 diabetes and have demonstrated their ability to improve research outcomes such as quality of life and blood sugar values in Type 2 diabetes patients (18). The usage of e-FRIDEM is intended to raise knowledge of DM risk groups and improve self-management of Type 2 DM prevention.

It is critical to assess learnability for user interfaces that are regularly used. A more learnable system minimizes the time required to complete tasks by allowing users to spend more time with it(13). The results graph illustrates the average time for responders to complete the questionnaire in the first and second trials. Sufficient data on first and recurring use enabled us to determine the improvement in time, errors, and perceived difficulty that could be expected after a few months of use. In most cases, the third trial completed the task faster than the first effort. In a few instances, task time was significantly reduced (often a 50 percent reduction).

This enabled us to discuss initial use performance (a typical usability test) and recurrent use performance. We were able to identify interface issues that resulted in persistent interaction problems even after users gained familiarity with the interface. Due to the fact that this research is the initial stage in the development of e-FRIDEM as a screening tool, the latter is hoped that in the future, it will be possible to test the instrument's use with a larger sample size.

## CONCLUSION

In this research, we investigated the potential of e-FRIDEM as a screening tool for Type 2 diabetes mellitus in Indonesia. As a result of the findings, we may conclude that this application is suitable for usage as a screening tool. We do not claim that the application's interface is exhaustive; instead, it serves as a starting point from which additional features and measures can be added as experience is gained.

## ACKNOWLEDGEMENT

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## REFERENCES

1. who. Country and Regional Data on Diabetes, WHO South East Asia Region [Internet]. 2016. Available from: http://www.who.org/Countryandregional-data-on-diabetes
2. Dyah P. Diagnosis dan Klasifikasi Diabetes Melitus. In: Buku Ajar Ilmu Penyakit Dalam. VI. Jakarta: Pusat Penerbit FK UI; 2014. p. 2323–6.
3. International Diabetes Federation. IDF Diabetes Atlas [Internet]. 10th ed. Boyko EJ, Magliano DJ, Karuranga S, Piemonte L, Riley P, Saeedi P, et al., editors. Diabetes Research and Clinical Practice. International Diabetes Federation; 2021. Available from: www.diabetesatlas.org
4. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2010;33(SUPPL. 1):562–9.
5. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. Diabetes Res Clin Pract [Internet]. 2019;157:107843. Available from: https://doi.org/10.1016/j.diabres.2019.107843
6. Garnita D. Faktor Resiko Diabetes Melitus (Analisis Data Sakerti 2007). Universitas Indonesia; 2012.
7. Aekplakorn W, Bunnag P, Woodward M, Sritara P, Cheepudomwit S, Yamwong S, et al. A risk score for predicting incident diabetes in the Thai population. Diabetes Care. 2006;29(8):1872–7.
8. Ramachandran D, Canny J, Das PD, Cutrell E. Mobile-izing health workers in rural India. Conf Hum Factors Comput Syst Proc [Internet]. 2010;3:1889–98. Available from: http://www.scopus.com/inward/record.url?eid=2-s2.0-77953986434&partnerID=40&md5=b3a216bce9b589bba0b209a89dfcff91
9. Gao WG, Dong YH, Pang ZC, Nan HR, Wang SJ, Ren J, et al. A simple Chinese risk score for undiagnosed diabetes. Diabet Med. 2010;27(3):274–81.
10. Lee YH, Bang H, Kim HC, Kim HM, Park SW, Kim DJ. A Simple Screening Score for Diabetes for The Korean Population: Development, Validation, and Comparison With Other Scores. Diabetes Care. 2012;35(8):1723–30.
11. Nurdina G, Putri TARK, Hayati SN. Usability Telecontextual Study for Nursing Students: Unfolding Case Study. KnE Life Sci. 2021;2021:697–704.
12. Rahadi DR. Pengukuran Usability Sistem Menggunakan Use Questionnaire Pada Aplikasi Android PENDAHULUAN Interface pengguna Android didasarkan pada manipulasi langsung menggunakan masukan sentuh yang serupa dengan tindakan di dunia nyata , seperti menggesek ( swiping. J Sist Inf [Internet]. 2014;6(1):661–71. Available from: http://ejournal.unsri.ac.id/index.php/jsi/index
13. Sauro J. How To Measure Learnability [Internet]. 2013. Available from: https://measuringu.com/measure-learnability
14. Hadi S. Efektivitas penggunaan video sebagai media pembelajaran untuk siswa sekolah dasar. In: Seminar Nasional Teknologi Pembelajaran Dan Pendidikan Dasar 2017. 2017. p. 96–102.
15. HADI RK. Evaluasi Usabilitas Aplikasi Navigasi Dalam Ruangan Pada Pusat Perbelanjaan. Institut Teknologi Sepuluh Nopember; 2017.
16. Sharfina Z, Santoso HB. An Indonesian adaptation of the System Usability Scale (SUS). Int Conf Adv Comput Sci Inf Syst. 2017;145–8.
17. Joyce A. How to Measure Learnability of a User Interface [Internet]. 2019. Available from: https://www.nngroup.com
18. Drion I, Pameijer LR, Van Dijk PR, Groenier KH, Kleefstra N, Bilo HJG. The effects of a mobile phone application on quality of life in patients with type 1 diabetes mellitus: A randomized controlled trial. J Diabetes Sci Technol. 2015;9(5):1086–91.