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DIABETES MELLITUS PATIENT CARE: AN ANDROID-BASED APPLICATION DEVELOPMENT MODEL FOR "TELOGOREJO DIABETES SELF MANAGEMENT EDUCATION"

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ABSTRACT

Diabetes self-management education (DSME) is a crucial tool for patient education. The development of an Android-based mobile phone application that can raise awareness, alter behavior, and enhance DM patients' self-management is required because traditional media-based education is ineffective at changing the way that patients manage their condition. The research aims to investigate the care needs of patients with diabetes mellitus through the creation of android-based applications that act as a communication tool for them. The study employs a research and development (R&D) method design. This study was carried out in March and April of 2023 in Semarang City. Twenty patients with diabetes mellitus made up the study's sample. The study employed snow ball sampling as a sampling technique, and the inclusion criteria included patients with diabetes mellitus for more than a year, ages 18 to 65, Android phone ownership, and literacy. There are multiple phases to this study. Respondents are asked to complete a number of questionnaires during the first stage with the Diabetes Knowledge Questionaire-24 (DKQ-24) (r-values= 0.425-0.904 and Cronbach's α= 0.757), the Morisky Medication Adherence Scale (MMAS-8) (r-values= 0.287-0.461 and Cronbach's α= 0.792) and the Self Care Management Questionnaire (r-values = 0.391-0.865 and Cronbach's α= 0.930), known as the analysis stage. Development of the application and due diligence constitute the second step. Based on characteristics of the respondents, indicates that sixty percent of individuals with diabetes mellitus are male, forty percent are between the ages of 46 and 55, and thirty percent have completed both senior high school and college, the majority of patients with diabetes had a low level of knowledge (50%), had a low adherence rate of 60%, the low category, with a self-care management level of 50%. The overall feasibility percentage results from the computation above demonstrate how effectively the "Tetes Madu" application is being used. In an effort to boost patients' self efficacy and enhance their self management, the "Tetes Madu" application was developed. This is a step in the right direction for modern healthcare.

Keywords: android based application development model; diabetes mellitus; DSME; tetes madu

INTRODUCTION

Patients with diabetes mellitus have elevated blood sugar levels as a chronic illness (Sun & Lin, 2023). The term "high blood sugar levels" refers to two different conditions, high blood sugar when more than 126 mg/dl when fasting and high blood sugar when more than 200 mg/dl (Sacks et al., 2023). These diagnostic thresholds are widely used in clinical practice to identify and confirm diabetes mellitus and to guide appropriate management and treatment strategies (ElSayed et al., 2023).

In 2023, it is estimated that around 537 million adults aged 20–79 years worldwide will be living with diabetes mellitus, which is equivalent to around 1 in 10 adults (±10.5%), indicating that diabetes remains one of the biggest global health problems (International Diabetes Federation, 2023). The prevalence of adult Diabetes Mellitus sufferers in Indonesia is in the range of 11-12% in 2023, which is relatively increased compared to the 2013 survey (around 10.7%) and 2018 (around 11.8%) (Muharram et al., 2025). 13.5% of those with diabetes mellitus are civil servants, TNI, Polri, BUMN, and BUMD patients (BKPK, 2023). Since

PNS/TNI/Polri/BUMN/BUMD worker are undoubtedly individuals with at least a diploma in education, it is implausible that they have diabetes mellitus because they "don't know". This strengthens the evidence that the high rate of diabetes mellitus cases in Indonesia is, in fact, a result of poor lifestyle choices, bad habits, and inadequate public health management (Indrahadi et al., 2021).

Furthermore, the outcomes of interviews concerning lifestyle, habits, and health management conducted with a number of patients diagnosed with type 2 diabetes mellitus in the community and hospital. The majority of diabetes mellitus patients were found to be bored with their dietary restrictions, bored with having to take their medications, and bored with having to take care of themselves, which led to intentional noncompliance with recommended practices (Rezaei et al., 2019). The majority of diabetes mellitus patients consciously block out information, guidance, and counsel from medical professionals (Mwila et al., 2019).

In addition, the role of the family in providing support is less than optimal, such as reminding to take medicine, reminding to eat according to diet, reminding to do self-care, and providing care to family members suffering from diabetes mellitus. Most families say they are tired, lazy, and no longer care about their diabetic family members because they frequently violate compliance. Actually, according to further research, diabetes mellitus patients experience mild to severe stress and depression as a result of prolonged treatment, which is accompanied by a lack of psychological support from family, the environment, and health professionals (Kamaryati & Malathum, 2020).

Diabetes mellitus patients will experience a decrease in quality of life if their self-efficacy or confidence in their ability to undergo treatment and treatment is not addressed. Diabetes Self-Management Education, or DSME as it is more commonly known, can boost self-efficacy. DSME is a process that facilitates diabetic patients' knowledge, skills, and self-care behavior skills (Kurniawati et al., 2021). According to DSME research, DSME can reduce the incidence of DM by 58% (Simbolon et al., 2020). According to research by Simbolon et al., (2020), using diabetes self-management education (DSME) with booklets significantly improves type 2 diabetes patients' knowledge, attitudes, and self-efficacy. It can also enhance quality of life and reduce complications by encouraging patients to practice optimal self-care in line with the guidelines in Diabetes Self-Management Education (DSME).

Self-management in chronic disease patients can improve clinical outcomes and quality of life (Lin et al., 2017). This is due to the fact that self-management has a significant impact on patient behavior and compliance with care. Using android mobile technology to improve self-management in chronic disease patients is currently very effective (Lewis et al., 2019). Kosa et al., (2019) discovered that android application interventions can have a positive impact on behavior, self-management, and all aspects of patient intake. According to Whitehead & Seaton (2016), the use of Android applications has a positive impact on health outcomes for chronic disease patients and has the potential to improve self-management independently.

An innovative approach based on Android mobile technology is a strategy that can help chronic disease patients improve their self-management, self-efficacy, and quality of life on their own because this process involves patients as partners in their own health alongside caring families (Donald et al., 2019). Patients with chronic illnesses may benefit from creative ways to use Android mobile technology media in the healthcare industry, leading to better health outcomes (Shen et al., 2019). The current Android application for DSME does not compute body mass index (BMI) or use an alarm to remind users to take their medications. It is not directly connected to a mobile device. Furthermore, some applications remain distinct in terms of their educational focus; for instance, they only cover the diabetic diet and exclude physical activity,

how to check blood sugar during a diabetic crisis, and how to administer insulin. In light of this context, researchers are aiming to create an Android application that offers knowledge and instruction on diabetes patient care, particularly in the area of diabetes self-management education. The app was named "Telogorejo Diabetes Self Management Education" by the researcher, which is shortened to "Tetes Madu" as a feature. The research aims to investigate the care needs of patients with diabetes mellitus through the creation of android-based applications that act as a communication tool for them.

METHOD

The study employs a research and development (R&D) method design. The ADDIE framework model—which consists of requirements analysis, concept design, and development—is the development model that is employed. This study was carried out in March and April of 2023 in Semarang City. Twenty patients with diabetes mellitus made up the study's sample. The study employed snow ball sampling as a sampling technique, and the inclusion criteria included patients with diabetes mellitus for more than a year, ages 18 to 65, Android phone ownership, and literacy. There are multiple phases to this study. Respondents are asked to complete a number of questionnaires during the first stage, known as the analysis stage. These include the respondent characteristics questionnaire, the Diabetes Knowledge Questionaire-24 (DKQ-24) (r-values ranged from 0.425 to 0.904 and Cronbach's α = 0.757), the Morisky Medication Adherence Scale (MMAS-8) (r-values ranged from 0.287 to 0.461 and Cronbach's α = 0.792) and the Self Care Management Questionnaire (r-values ranged from 0.391 to 0.865 and Cronbach's α = 0.930). Based on the findings of assessing the knowledge, compliance, and self-care management of patients with diabetes mellitus, researchers believe that Android-based DSME educational applications are necessary at this initial analysis stage.

Development of the application and due diligence constitute the second step. Researchers asked participants to bring an Android phone, assist with installation, and use the application for 30 to 45 minutes. Afterwards, participants were asked to complete a questionnaire regarding their evaluation of the "Telogorejo Diabetes Self Management Education" application. The ISO 9126 is the tool feasibility. The researchers in this study adhere to the two main research ethics: expediency (beneficence) and respect for human dignity. fairness (Jusctice). After outlining the goals and advantages of the study, the researcher will ask respondents to fill out an informed consent form indicating their willingness to be the subject of the study. The Telogorejo Semarang Ethics Committee of STIKES has approved this research with the number 003e/III/KE/STIKES/2023.

RESULT

Analysis Phase

Tabel 1.
Respondent characteristics

Variable	f	%
Gender		
Man	8	40
Woman	12	60
Age		
18-25 years old	2	10
26-35 years old	5	25
46-55 years old	8	40
56-65 years old	5	25
Education Level		
Elementery school	4	20
Junior high school	4	20
Senior high school	6	30
Collage	6	30

Based on the characteristics of the respondents, the table indicates that sixty percent of individuals with diabetes mellitus are male, forty percent are between the ages of 46 and 55, and thirty percent have completed both senior high school and college.

Table 2.
Knowledge of patients with diabetes mellitus

Variable	f	%
Knowledge Level		
Low	10	50
Middle	6	30
High	4	20

The majority of patients with diabetes had a low level of knowledge, with 50% of them having diabetes mellitus, according to the results of measuring patient knowledge using the Diabetes Knowledge Questionaire-24 (DKQ-24).

Table 3.
Diabetes mellitus patients' adherence

Variable	f	%
Adherence Level		
Low	12	60
Middle	6	40

The Morisky Medication Adherence Scale (MMAS-8) questionnaire was used to measure the compliance of patients with diabetes mellitus. The results showed that the majority of these patients had a low adherence rate of 60%.

Table 4
Self care management of patients with diabetes mellitus

Variable	f	%
Level		
Low	10	50
Middle	8	40
High	2	10

After measuring self-care management in patients with diabetes mellitus, it was discovered that most of these patients fell into the low category, with a self-care management level of 50%. According to the needs analysis conducted using questionnaires, the majority of diabetes mellitus patients scored poorly in terms of knowledge, compliance, and self-care management. This calls for ingenuity in developing user-friendly applications that can alter the knowledge, behavior, and compliance of individuals with diabetes mellitus in their everyday at-home care.

Development Phase

Researchers created an application for diabetes self-management education based on the findings of the needs analysis. It was then improved in a number of ways to increase its acceptability and use among diabetes mellitus patients. Tetes Madu, an acronym for Telogorejo Diabetes Self-Management Education, is the name of this DSME educational innovation application. There are nine main menus and numerous submenus with different content in this app. The nine primary menu items are: GDS Check, DM Foot, DM Ulcer, DM Diet, Meal Plan, Taking Medicine, Insulin Injection, and Psychological Therapy.

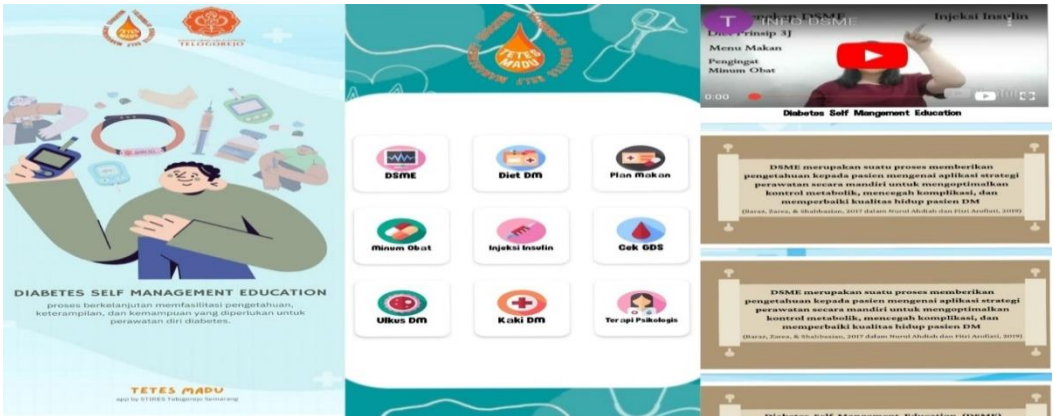

Figure 1. Application front view with an explanation of DSME

Figure 2. Display of diabetes mellitus diet menu and BMI calculation in the application

Figure 3. Menu display for meal planning

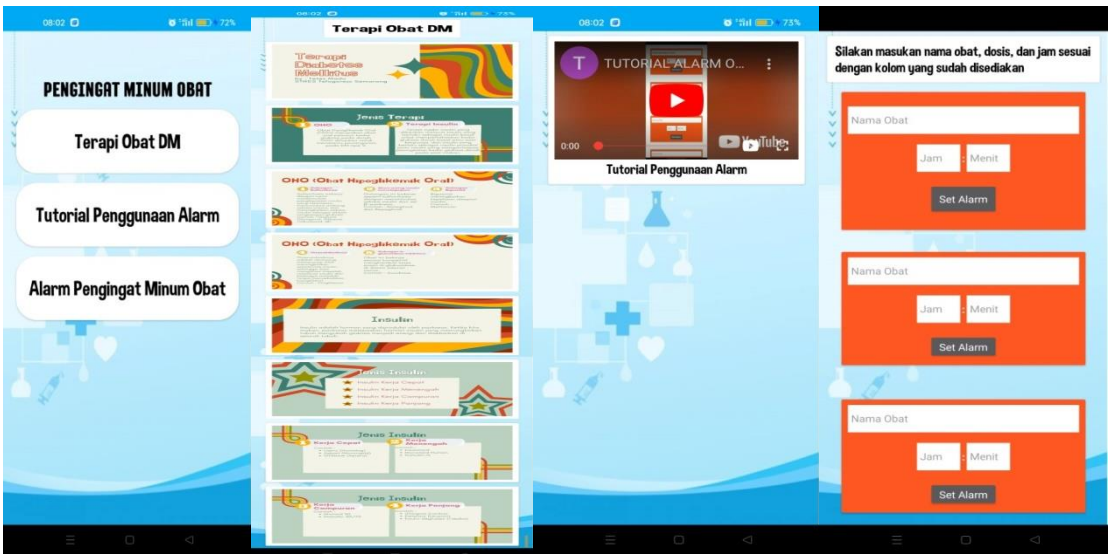

Figure 4. The menu for the medication reminder

Trial Phase

Twenty patients with diabetes mellitus were tested using the updated "Telogorejo Diabetes Self Management Education" application. Researchers asked participants to bring an Android phone, assist with installation, and use the application for 30 to 45 minutes. Afterwards, participants were asked to complete a questionnaire regarding their evaluation of the "Telogorejo Diabetes Self Management Education" application. The SUS (System Usability Scale) questionnaire is the tool utilized.

Tabel 5.
Application Feasibility Test

Test	Results	Information
Functionality	90%	Very good
Usability	90%	Very good
Efficiency	95%	Very good
Maintainability	95%	Very good

The overall feasibility percentage results from the computation above demonstrate how effectively the "Tetes Madu" application is being used.

DISCUSSION

Android application-based media can increase patient interest and serve as a reminder of a stimulus to change behavior in the future (Timmers et al., 2020). Individual behavior is influenced by predisposing, enabling, and reinforcing factors. An Android smartphone app with

a long-term impact on self-management can send automated messages as triggers for self-management. Therefore, it is necessary to have the ability to manage one's behavior. This ability is often referred to as self-management. Diabetes Independent Management Education is a health education process for individuals or families to manage diabetes. DSME uses guidelines, counseling and behavioral interventions to increase knowledge about diabetes. In the health sector, information can be an important factor in people's lives, especially in accessing personal and family skills improvement services in diabetes management (Santo et al., 2016).

Research by Anggraeni et al., (2018) demonstrates that patients' increased self-care behavior is impacted by receiving structured education gradually. DSME is one educational intervention that patients with type 2 diabetes mellitus may receive. DSME encourages patients to make decisions and take care of themselves, resulting in improved knowledge, attitudes, and behaviors. Patients will be encouraged to self-manage and control their diabetes with this increase.

The development of diabetes self-management training is part of the progress of information technology in health services. Diabetes self-management training conducted by researchers called Tetes Madu on an Android smartphone is an application that has undergone development stages regarding the provisions of ISO 9126 concerning functionality, efficiency, and maintenance tests. All levels are achieved with an average value of 92.5 with a value of "very good." The use of smartphones in the development of information technology also needs to find applications in the medical field. Research shows that Android mobile phone applications can be useful in all aspects of human life in treating diabetes patient (Szyjewski & Fabisiak, 2018).

A scrollable explanation and a general video about DSME are both available on the DSME menu. The 3J Principle (Amount, Type, and Schedule), Guidelines for the Number of Meals, Calculation of Calorie Needs, and Calculation of Body Mass Index (BMI) are the four sub-menus on the DM Diet menu. An educational video about the proper meal plan, proper portion sizes, and proper food types can be found in Principle 3J. There are also readable and scrollable explanations included with this submenu. The different food types and their calorie counts are explained in videos on the Eating Amount Guide. Alongside this sub-menu, there is an explanation available on slides that can be read about the food calorie table and sample menus in a single day. An animated video on the Calorie Needs Calculation page explains how to compute calories using a formula. Explanations, tables for calculating calorie requirements, and one of the unique features the calorie needs calculator are also included in this submenu. An animated video on BMI calculation walks viewers through the process of calculating BMI using the formula. Alongside this sub-menu are examples of calculations, a description of the weight status table, and one of the unique features the BMI calculator. According to research by Azizah et al., (2019), type 2 DM patients' knowledge can be increased through nutritional counseling using the Nutri Diabetic Care application, which includes the 3J DM diet or type, amount, and schedule.

The Meal Plan menu offers sample menus for seven days with total calories measured so that diabetic patients can eat in accordance with their calorie requirements. The Take Medicine menu comprises three sub-menus: medication reminder alarms, tutorials on how to use alarms, and DM drug therapy. An application user-readable explanation slide about the kind of drug therapy is included in the DM Drug Therapy sub-menu. A brief instructional video explaining how to use the medication alarm via the Tetes Madu app can be found in the Alarm Use Tutorial sub-menu. A column on the Medication Reminder Alarm sub-menu allows you to set the alarm based on the needs of the patient. According to research by Harahap et al., (2020), patients' knowledge and compliance with medication can be increased through the use of medication reminders.

An instructional slide and a video explaining insulin injection procedures can be found on the Insulin Injection menu. An instructional video and slide about GDS are included in the Check GDS menu. It also provides instructions on how to check blood sugar and GDS. There is a video explaining how to treat diabetic ulcers on the menu for DM ulcers. The findings study of Apriliana (2022) indicate that insulin adherence and glycemic control in patients with type 2 diabetes are impacted by insulin injection video education.

Three sub-menus are available under the DM foot menu: Physical Exercise Activities, DM Foot Gymnastics, and Foot Care. A readable explanation slide and a video detailing foot care for diabetic patients can be found under the Foot Care submenu. A written explanation slide and a video tutorial on how to perform DM foot gymnastics can be found under the DM Foot Gymnastics submenu. A video that explains how to perform physical exercise activities for patients with diabetes mellitus is included in the Physical Exercise Activity sub-menu, along with reading slides. Role-playing videos of psychological therapy being implemented are available on the Psychological Therapy menu, along with readable explanation slides. The ability of type 2 DM patients to take care of themselves is impacted by the use of videos as a medium for health education (Tamara et al., 2023).

According to the American Association of Clinical Endocrinologists (AACE) and the American Diabetes Association (ADA), mobile health technology needs to support patients and healthcare providers with features that allow self management practices to adhere to established standards. A smartphone based application that combines daily independent blood sugar control, medication, diet, physical activity, weight control, blood pressure control, and education about diabetes self management through the use of routine tips, emails, videos, or short message services is one way that the ADA and AACE have determined what constitutes self-management (Greenwood et al., 2017).

Studies by Widyanata, (2018) demonstrate that the DM calendar application for Android offers positive reinforcement and motivates users to follow regular blood sugar control, exercise regimens, and diet plans. Patient perceptions of their own self-efficacy in taking care of themselves have improved thanks to education through electronic media. Glycemic profile (HbA1c) changes toward conrol or less than 7 according to patient empowerment, which enhances patients' ability to practice good self-care control independently for 90 days.

CONCLUSION

In an effort to boost patients' self-efficacy and enhance their self management, the Telogorejo Diabetes Self Management Education application "Tetes Madu" was developed. This is a step in the right direction for modern healthcare. The management of the disease, the DM (3J) diet, BMI calculations, blood sugar monitoring, lifestyle modifications, medication reminders, complication prevention, and DM foot care can all be greatly aided by these apps.

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