

The effect of mobile learning application in enhancing students' knowledge of caring sepsis patients

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ABSTRACT

Sepsis is one of the major causes of death in hospitalized worldwide, but there are many nurses who have insufficient knowledge about sepsis. The use of mobile phones as learning devices potentially improves knowledge in nursing education in the pre-clinical stage. The study aimed to determine the effectiveness of mobile learning application in improving nursing students' knowledge about sepsis and its nursing care. This research was a pre-experimental study with the one-group pretest-posttest design. The study involved 57 students in the Nursing Department, Faculty of Medicine, Brawijaya University. Their knowledge levels were measured before and after they used mobile learning applications. The nursing students' age was 19-24 years old; 93% were female; 82% of students had received information about sepsis from course materials and the internet, and 65% were currently studying the Nursing Profession Program. The median value of the interquartile range pretest was $40_{\pm 20}$, and $70_{\pm 30}$ for the posttest. The statistical test showed a significance value of 0.000 ($p < 0.05$); there were significant differences in students' knowledge levels before and after using the mobile learning application. Using the mobile learning application can effectively enhance nursing students' understanding of sepsis care.

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1. INTRODUCTION

Sepsis is considered the primary cause of patient mortality related to infectious diseases in hospitals worldwide [1], [2]. The global incidence rates for sepsis (hospital-treated sepsis) and severe sepsis (hospital-treated severe sepsis) were 437 and 270 cases per 100,000 person-years, with mortality rates reaching 17% and 26% [3]. Treatment of septic patients must be carried out quickly, precisely, accurately, and safely because delaying the management of sepsis can increase patient mortality [4].

Scientific research on sepsis has undergone various changes and developments. For instance, the old definition defined sepsis as a combination of infection and systemic inflammatory response syndrome (SIRS); at the molecular level, infectious and non-infectious causes of inflammation are similar, i.e., they all activate blood coagulation, inflammatory cytokines, and tissue repair pathways, making it difficult to differentiate between the two in the early stages of the disease [5]. Moreover, in 2016, The Sepsis Definition Task Force

redefined sepsis as life-threatening organ dysfunction caused by the body's unbalanced response to infection. Organ dysfunction is characterized by the sequential (sepsis-related) organ failure assessment (SOFA) or the quick sequential organ failure assessment (qSOFA) scores that increase by at least two points [6]. These changes impact reforming the management and care of sepsis patients.

Nurses at the forefront of health services in the hospitals play a capacity in receiving patients, accompanying them for 24 hours, monitoring hemodynamics, and performing other necessary actions; thus, the active contribution of nurses in preventing and managing sepsis in hospitals needs to be strengthened. However, many nurses identified insufficient knowledge and ability to recognize and manage sepsis as barriers for effective sepsis management [7], [8]. Indeed, the effort in learning about sepsis management in hospitalized patients began in the nursing education process in the pre-clinical phase.

It is necessary to provide thorough and easily accessible information about sepsis to the nursing students as prospective nurses, considering the current students categorized as Generation Z. This generation's learning characteristics are independent, auto didactic, passionate in technology, and specific to online channels [9]. They were born in the advanced technological era; thus, they are accustomed to using digital devices to learn and connect with others and become the high customers of technology [9], [10]. Some studies found that smartphones are consequential devices to assist generation Z's daily activities; most of them spend over three hours, even nine hours or more, using their mobile phones in a typical day not only for communication but also for social media and other purposes [11]. Obviously, these phenomena should be considered in evolving effective learning methods for current students.

The use of information and communication technology in the teaching and learning process beneficially improves knowledge and develops skills in multifaceted fields and levels of education [12], [13]. Nursing has been used this technology in education and health services widely, such as virtual reality, electronic learning, mobile learning, and technology-enabled self-management for diabetes patients to improve theoretical knowledge, encourage the application of conceptual understanding in clinical practice as well as optimize patients' health outcomes [14]–[17]. In addition, the e-platform was used for the teaching and learning process as an educational tool that is informative, fun, interactive, attractive, convenient, assists in improving confidence, and facilitates practical learning [18], [19]. Certainly, the internalization of technology in the nursing process can optimize students' critical thinking efforts through dynamic and contemporary activities [19].

Subsequently, the utilization of online applications for the learning process, including Zoom, Google Classroom, and Skype, has been remarkably approved during the current COVID-19 pandemic [20]. Applying technology allows students to gather scientific information to improve their knowledge without leaving the house for a virus transmissions precaution. A study by Lozano *et al.* found a significant difference in participants' theoretical knowledge between participants who used mobile learning applications and traditional learning, in which the average exam score of the intervention group was higher than the control one [21]. Fernandez-Lao *et al.* also conducted a study related to the use of the mobile learning application as a complement to traditional learning in undergraduate physiotherapy students and found that the mobile app was functionally bolstered traditional learning, particularly developing skills in ultrasound and palpation of the shoulder region [22].

The advance in technology has affected information retrieval in which many scientific articles are available online and easily accessible through free resource databases. In these situations, mobile learning has been authorized in many educational institutions, allowing students to obtain academic content efficiently [23]. Mobile learning (m-learning) is described as electronic learning through portable devices such as smartphones. M-learning enables innovative teaching and studying approaches to promote students' involvement with considerable connectivity with other learners and scientific resources across multiple circumstances [24], [25].

However, the students at Nursing Departments University of Brawijaya have not used m-learning in the learning process of nursing care for sepsis patients. Therefore, this study aimed to assess the effectiveness of the mobile learning application in enhancing nursing students' knowledge about sepsis and its nursing care. This study results are important to determine the efficacy of m-learning to elevate students' knowledge about sepsis.

2. RESEARCH METHOD

This research was pre-experimental with the one-group pretest-posttest design. The research participants were the students of the Nursing Department, Faculty of Medicine, Brawijaya University. A purposive sampling technique was used in this research. The inclusion criteria were minimum the students in the second year, and they have been used gadgets actively, and the study exclusion criteria were students who were not academically active. The minimum sample size was determined by considering the values of $X_1=29.07$, $X_2=26.23$, $S=4.51$ [26], with 95% confidence interval and 5% error. Participants of this research were 57 students.

The study was conducted in the Nursing Department, Faculty of Medicine, Brawijaya University, in October-November 2021. All participants have received an explanation of the research and informed consent, and the identity of the respondents was kept confidential by the researchers. Respondents did the pretest, subsequently used the m-learning application as a learning medium for three days, and finally, they were asked to fill out the posttest. The level of knowledge was measured using a questionnaire, which was administered before and after respondents used the m-learning application. The form included ten questions regarding sepsis definition, risk factors, scoring system, pathophysiology, clinical manifestations, sepsis bundle, and nursing cases. The knowledge level questionnaire has a score of 0-100.

The m-learning application can be downloaded through the play store by entering the keyword: SepsisCare. The application contains information and educational content tailored to the learning needs of nursing students and nurses based on scientific references, with detail is described in Table 1.

Table 1. The m-learning application features

Subjects	Topic	Sub-topic	
Sepsis review	Sepsis epidemiology		
	Definition	Definition Differences in each definition of sepsis (Sepsis-1, Sepsis-2, and Sepsis-3)	
Sepsis Calculator	Sepsis etiology		
	Risk factor		
	Pathophysiology		
	Sepsis identification	Scoring systems (SOFA, qSOFA, NEWS 2)	
	Clinical manifestation	Heart	
		Main (constitutional)	
		Dermatology	
		Endocrine	
		Gastrointestinal	
		Genitourinary	
Hematology			
Hepatic			
Pulmonary			
Sepsis Calculator	SOFA calculator	Renal	
		Respiration	
	qSOFA Calculator	Coagulation	
		Liver	
		Cardiovascular	
		Central nerve system	
		Renal	
		Low blood pressure/hypotension	
		Respiratory rate	
		Level of consciousness	
NEWS 2 Calculator	Respiratory rate		
	Oxygen saturation		
	Temperature		
	Systolic blood pressure		
	Pulse		
	Level of consciousness		
Sepsis bundle	Introduction		
	One hour bundle		
	Others bundle	Three hours bundle Six hours bundle	
Nursing care	Ineffective airway clearance	Outcomes of caring and nursing intervention	
	Ineffective breathing pattern		
	Impaired spontaneous ventilation		
	Impaired gas exchange		
	Risk of shock		
	Risk of unstable blood glucose levels		
	Nutrition deficit		
	Impairment of skin integrity		
	Self-care deficit		
	Ask a question		
Discussion forum	Scientific articles related to sepsis		
	Surviving sepsis campaign		
Blog	Society of critical care medicine		
	American Association of Critical Care		
External link	Nurses		
	The UK Sepsis Trust		
Scientific references	References related to <i>SepsisCare</i>		
	<i>SepsisCare</i> creators		

The Statistical Package for Social Science for Windows 24 (SPSS 24) program was used to evaluate the data, with a significance level or probability value of 0.05 ($p=0.05$) and a 95% confidence level ($\alpha=0.05$). Statistical tests were carried out either univariate or bivariate, while the univariate test produced descriptive data in the form of a result description of the respondents' demographic characteristics, bivariate analysis in the form of respondents' knowledge level that was presented in the median value (Med) \pm interquartile range (IQR). Additionally, a different test was conducted to determine the effectiveness of the application in improving respondents' knowledge using the Wilcoxon test. This research has obtained the Ethical Approval Statement No. 238/EC/KEPK/08/2021. All participants have received an explanation of the research and informed consent, and the identity of the respondents was kept confidential by the researchers.

3. RESULTS AND DISCUSSION

Data of the participants' characteristics Table 2 showed that all respondents were 19-24 years old, with above 90% female. The 82% of the students said they had received information about sepsis from course materials and the internet, and two-thirds were currently studying the Nursing Profession Program. Also, most respondents have received information about sepsis through the study of nursing courses.

Table 2. Characteristics of the participants

No.	Items	n	Percentage (%)
1.	Age (years old)		
	19-24 years old	57	100
2.	Gender		
	Male	4	0.7
	Female	53	93
3.	Get information about sepsis		
	Ever	47	82
	Never	10	18
4.	Education		
	Undergraduate nursing program	20	35
	Nurse profession education	37	65

The pretest-posttest score median of the students is presented in Table 3. Based on the data, above 75% of the respondents' knowledge level scores elevated after using the m-learning application Table 4. The normality test showed that the data distribution in this research was not expected, so it was continued with the Wilcoxon non-parametric difference test to determine the effectiveness of the application in improving students' knowledge. The Wilcoxon test showed a significant result of 0.000 ($p<0.05$), which means that there was a considerable difference in knowledge before and after using the m-learning application.

Table 3. The participants' pretest and posttest scores

	Median \pm Interquartile range (IQR)	p-value
Pretest	40 \pm 20	0.000
Posttest	70 \pm 30	

*Significant if <0.05

Table 4. The changes of the posttest knowledge level compared to the pretest

Knowledge level score	n	Percentage (%)
Increase	44	77
Decrease	9	16
Same	4	7
Total	57	100

The m-learning application is an option for nursing students to retrieve complementary literacy regarding sepsis, considering students tend to have good knowledge in utilizing Android-based mobile learning. Most students have felt the benefits of android in helping their learning activities, such as facilitating the learning process, providing motivation, and helping to get references to the required course material. Indeed, the easily accessible m-learning application allows students to study anytime and anywhere.

Today, mobile devices have similar functions to desktops because smartphones can do many operations like a computer [27]. A meta-analysis study by Sung *et al.* revealed numerous combinations of hardware, software, and intervention time of portable digital devices had been studied for the participants in

different age ranges in implementation settings and teaching methods. The results showed that mobile applications for educational purposes are better than desktop computers or laptops, and medium and short-term use is better than long-term. Mobile devices have specific features, including personalized interfaces, immediate information access, context sensitivity, and users communication that promote adult learning, such as self-directed learning or formative assessment [28]. Obviously, m-learning possibly bring a fundamental change in the knowledge dissemination method to promote the quality of teaching in respecting the international standard.

This study indicates a notable effect between the use of the m-learning application and the student recognition of caring for sepsis patients. The content of the m-learning application, which includes a sepsis review, a sepsis calculator, and nursing care for sepsis patients, is designed to make it effortless for nursing students and nurses to understand comprehensive sepsis management with quick access. The mobile certainly supports users to review sepsis theory and guidelines quickly. According to a study by Kang *et al.* mobile health applications with features that describe the disease and its interventions can significantly strengthen the cognitive ability and influence user clinical satisfaction because health information can be accessed quickly and comprehensively compared to sizeable traditional reference books or e-books [26]. The easiness of gaining information anywhere and anytime is an important key point recognized to improve students' academic achievement through mobile learning.

In addition, the features of the application make it easier for users to get the information needed in the management of sepsis patients. For example, to facilitate identification in the assessment process, a sepsis calculator contains calculation options using SOFA, qSOFA, and NEWS 2 scores and their interpretations. Moreover, in the sepsis management feature, users can use bundles that suit their needs, namely one hour, three hours, and six hours. Quick access to septic treatment guidelines is needed because speed plays an essential role in the therapy of septic patients to improve their outcomes. A study conducted by Sari *et al.* implied that patients with SOFA scores ≥ 7 had a mortality rate of 72.6%, which is higher than patients with SOFA scores < 7 by 35.8% [29]. Early identification and treatment from the first hour are consequential to reducing mortality in sepsis patients in the hospital.

In the m-learning, users can also do interactive learning with the Discussion Forum feature, which authorizes users to discuss sepsis. Discussion is part of the learning process that can allow users to exchange information, express opinions, and communicate critical analysis, positively influencing user knowledge and understanding. A study done by Kim and Suh [30] demonstrated that interactive mobile applications with structured, attractive, and easy-to-learn content significantly improved nursing students' knowledge after one-week intervention. Undoubtedly, an effective instructional strategy is needed to optimize the positive impact of learning technology.

Furthermore, interactive feature plays an essential role in m-learning applications because it allows educational socialization between users, teacher and learner, or among learners at a distance to improve effective collaboration in understanding some issues [31]. The m-learning can be adjusted for project-based learning, case study, brainstorming, and other collaborative learning methods. These academic activities potentially bolster student motivation and encourage pedagogic learning in which influential factors improve students' knowledge of specific learning topics [23]. Certainly, active teacher participation is needed to amplify students' discussion productivity [32].

However, the results of this study indicated that there were some users whose post-test scores were the same or even lower than the pre-test scores after using the m-learning. Some situations may relate to this condition. First, researchers have not been able to monitor user activity using the application directly; thus, some users may not explore all the features in the application. Second, users' time to access the application is relatively short, only three days. This outcome is in line with a study on evaluating the use of m-Health in increasing Latin adolescents' understanding of contraceptive use, which emphasizes that users may not complete using the application due to lack of time to do it routinely in the long term and insufficient monitoring in using the application [33].

There were three limitations to the study: the number of participants, intervention supervision, and study design. First, this study involves the participants, limited to one institution; consequently, the results cannot be generalized to the whole population. Second, the data was obtained from a self-report in which the researcher could not ascertain the regular operation of the m-learning app. Finally, the limitation of this study is related to the study design, which is a pre-experimental study that only compares the level of knowledge in one group.

4. CONCLUSION

M-learning is relevant to digitalization advancement in education fields, widely used by university students. In this study, the nursing students acquired information concerning sepsis overview and nursing care of sepsis patients. This study's results revealed that the mobile learning application effectively increased

nursing students' knowledge about sepsis and its nursing care. Based on this research, there are two recommendations suggested for further research. Firstly, the usage time of the m-learning app should be examined at several different times to determine the optimal ones, and the study sample should be enlarged by using experimental studies.

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