ORIGINAL ARTICLE

Developing a Mobile Application as a Learning Medium on Maternal Emergencies Related to Postpartum Hemorrhage

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ABSTRACT

Maternal mortality (MM) remains a problem in the world as 380 mothers die from complications related to pregnancy and childbirth worldwide. Postpartum hemorrhage is the world's leading cause of maternal mortality. In Indonesia, there were 8,600 maternal mortality cases in 2017, while the target to be achieved by 2025 is 74 per 100,000 live births. The aim of this study was to develop a mobile application as a learning medium on maternal emergencies. A research and development (R&D) study was conducted on 56 midwifery students, who were selected by total sampling. The KGD (KeGawatDaruratan) Maternal application was developed by using the ADDIE (analyze, design, develop, implement, evaluate) instruction model and was validated by two experts, namely, midwifery and media experts. The KGD Maternal application was assessed by midwifery students using structured questionnaires named the Technology Acceptance Model (TAM) questionnaires, which covered perceived ease of use (PEOU) and perceived usefulness (PU). The results of this study revealed that the KGD Maternal application was considered valid by the material expert and very valid by the media expert. As many as 69.6% of the midwifery students rated the KGD Maternal application as useful in the learning process on maternal and neonatal emergencies, and 73.2% rated it as easy to use. This study also revealed that the KGD Maternal application could provide greater opportunities for midwifery students to access, and facilitate and enable them to understand, materials about maternal emergencies. Based on the findings in this study, institutions of midwifery and nursing education should design and develop learning media that can provide a more optimal learning process. Furthermore, a higher extent of mobile application development is needed to provide better learning media. Increased knowledge and competency will clearly result in decreased maternal mortality.

Key words: e-learning, postpartum hemorrhage (PPH), maternal mortality

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INTRODUCTION

Maternal mortality (MM) remains a problem in the world as 380 mothers die from complications related to pregnancy and childbirth worldwide.[1] The World Health Organization (WHO) defines maternal mortality as maternal deaths that occur during pregnancy up to 42 days after delivery, caused by complications in pregnancy and its management.[2] Heavy bleeding after giving birth can cause death of the mother if not treated for more than 2 hours.[3] Postpartum hemorrhage (PPH) is the leading cause of maternal death worldwide, and PPH is an indicator of quality for obstetric care.[4] PPH as one of the contributors to the incidence of maternal emergencies has also been the main cause of maternal death.[5,6] The maternal mortality rate in Indonesia in 2017 was 8,600,[2] while the target to be achieved by 2025 is 74 per 100,000 live births.[7]

Based on the research by De Cássia de Oliveira & Barbosa Davim[5], heavy PPH can be caused by, among others, uterine atony, uterine inversion, placental abruption, abnormal placenta, disseminated intravascular coagulation, and pre-existing coagulation disorders. PPH is a greater risk for primiparous and grandemultiparous women by 1.69 times.[8] PPH as one of the causes of maternal mortality can be prevented by well-known health services and management of childbirth complications.[3] Maternal mortality can be reduced by adequate management of PPH.[6,9] Basic prenatal care is one of recommended measurements to identify the risk factors for PPH and the management.[5] Maternal mortality can also be reduced by effective policy and program interventions.[10] Declines in maternal and infant mortality rates and higher qualities of maternal and infant care are strongly influenced by midwifery practices and the competencies of the midwives.[11] Midwifery competencies are obtained by midwives during the learning process at midwifery institutions. Producing competent and professional midwives is an important role of midwifery education.[12] Better learning outcomes can be obtained with learning resources that are more creative, interesting, and easy to understand.[13]

Mobile phones and smartphones have been used by health workers as learning and practices media in basic emergency obstetric and newborn care (BEmONC). Previous studies shown a significant increase in health workers' (nurses, midwives, and medical doctor) knowledge and in BEmONC self-confidence after implementation of Safe Delivery App (SDA).[14,15] Mobile phone also have been used in several setting including hospitals and community, in order to improve maternal, newborn, and child health.[16-18] Smartphones were used on reduction of homebirths.[17] Furthermore smartphones was enable the management of pregnant women, health care professionals may make a critical decision based on information from an mobile application and increased the number of antenatal care attendance.[18-20]

Previous research has shown that the use of an e-learning system could enable the learning process to run more optimally.[21,22] The knowledge and skills of midwifery students saw an increase since the use of technology in learning.[23,24] Using e-learning-based media that are different, unique, and well-prepared can support the development of skills, knowledge, and behavior of nursing students.[25] It can thus be concluded that learning using e-learning-based media can improve students' knowledge, skills, and behavior. Against this background, this study was performed to investigate the development of an e-learning-based medium (the KGD Maternal mobile

application) for maternal emergencies related to PPH learning

METHODS

Study design and population

This study was a research and development study in use of the instructional system design with the ADDIE (analyze, design, develop, implement, evaluate) model. Information about the mobile application for maternal emergencies related to PPH named KGD Maternal, a link to download the application, and a guidance for students to install the application were provided.

All the midwifery students taking the Maternal and Neonatal Emergencies course at STIKES Tri Mandiri Sakti, Bengkulu, Indonesia, numbering 56 people, were recruited in this study. A meeting over Zoom Meetings was conducted to inform the students about the study and to derive their informed consent via Google Forms, given that this study was conducted during the COVID-19 pandemic. The midwifery students of STIKES Tri Mandiri Sakti used the KGD Maternal application during lectures on maternal and neonatal emergencies as a learning medium. After finishing their maternal and neonatal emergencies class, the students were distributed with the PEOU and PU questionnaires by the lecturer to be filled out.

Instruments

The validity of the KGD Maternal mobile application was assessed by two experts, namely a media expert (with a 12-item questionnaire) and a midwifery expert (with a 10-item questionnaire). The evaluation of the usefulness and ease of use of the KGD Maternal application was carried out using the Technology Acceptance Model (TAM) questionnaires by Davis[26], consisting of an 11-item questionnaire on perceived usefulness (PU) and an 11-item questionnaire on perceived ease of use (PEOU). The instruments were tested on 30 respondents who had the same characteristics as the research subjects. The validity was tested using the Pearson product-moment correlation coefficient, with the r_{count} being 0.35–0.74 ($> r_{table} = 0.31$). The minimum acceptable Cronbach's alpha coefficient is 0.70.[27] The Cronbach's alpha coefficient obtained for the instruments used in this study was 0.74, so the instruments were considered acceptable. The questionnaires used a 5-point Likert scale covering degrees from strongly agree (5), agree (4), and neutral (3), to disagree (2) and strongly disagree (1). The possible score ranged from 11 to 55, with high score indicating greater ease and usefulness. The data were found not normally distributed, so the perceived usefulness was divided into two levels based on the median, useful (≥ 45) and unuseful (< 45) while the perceived ease of use was divided into two levels based on the median, easy (≥ 39) and difficult (< 39).

Data Collection

Data were collected from September 2020 to October 2020. The participants recruited were taking the Maternal and Neonatal course in the midwifery program at STIKES Tri Mandiri Sakti. The midwifery students then signed a consent form, and each of them was asked to complete the questionnaires at the end of the course.

Ethical Considerations

This study was formally approved by the Health Research Ethics Committee of the Health Polytechnic of Bengkulu of the Ministry of Health (KEPK/067/10/2020). An informed consent was obtained from each respondent. Participation in the study was anonymous, voluntary, and low risk.

RESULTS

The development of the e-learning-based medium (mobile application) on maternal emergencies related to PPH was carried out with the ADDIE model, which consists of several stages, namely to analyze, design, develop, implement, and evaluate.

Analysis

The analysis stage was carried out to obtain information concerning the learning medium on maternal emergencies related to postpartum hemorrhage, consisting of information on the availability of the learning medium and the suitability of the learning medium for the needs of the midwifery students of STIKES Tri Mandiri Sakti Bengkulu. The analysis was performed through interviews with the lecturer and the first-semester students of the midwifery program in the Maternal and Neonatal Emergencies course. It was found that there was a lack of activeness among the midwifery students in the learning process. Undergoing lectures online due to the conditions of the COVID-19 pandemic, the students were less enthusiastic about reading and learning the materials provided by the lecturer through Google Classroom, WhatsApp group, and e-mail.

Design

The concept of the KGD Maternal mobile application on maternal emergencies related to postpartum hemorrhage was developed at this stage, in which the module, software program, and materials on maternal and neonatal emergencies were designed and determined. The applications required to develop the Android-based learning medium "KGD Maternal" that is concerned with maternal emergencies related to postpartum hemorrhage are as follows: Android Studio, Adobe XD, and Application Programing Interface (API). Adobe XD was used in this study to design the display on Android and to simulate the application. The coding process and development of the KGD Maternal application was performed using Android Studio. Meanwhile, Application Programing Interface (API) was used as a virtual emulator, in which case the KGD Maternal application was tested in 4 versions of the Android operating system API: versions 26, 28, 29, and 30. Simulation was carried out so that the KGD Maternal application can be used in all Android versions. This phase is illustrated in the following figures:

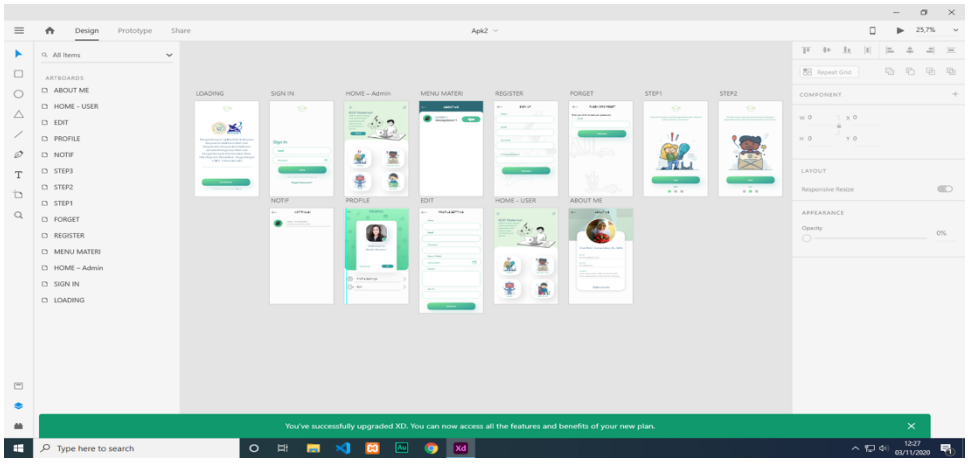

Figure 1 Application Design Development Window on Adobe XD

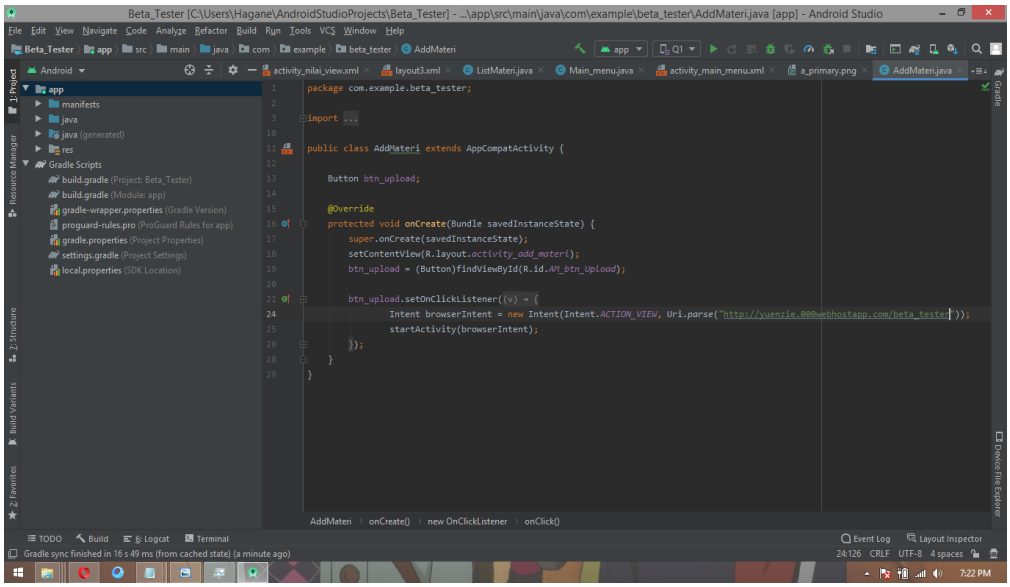

Figure 2 KGD Maternal Application Interface/Coding Working Window on Android Studio

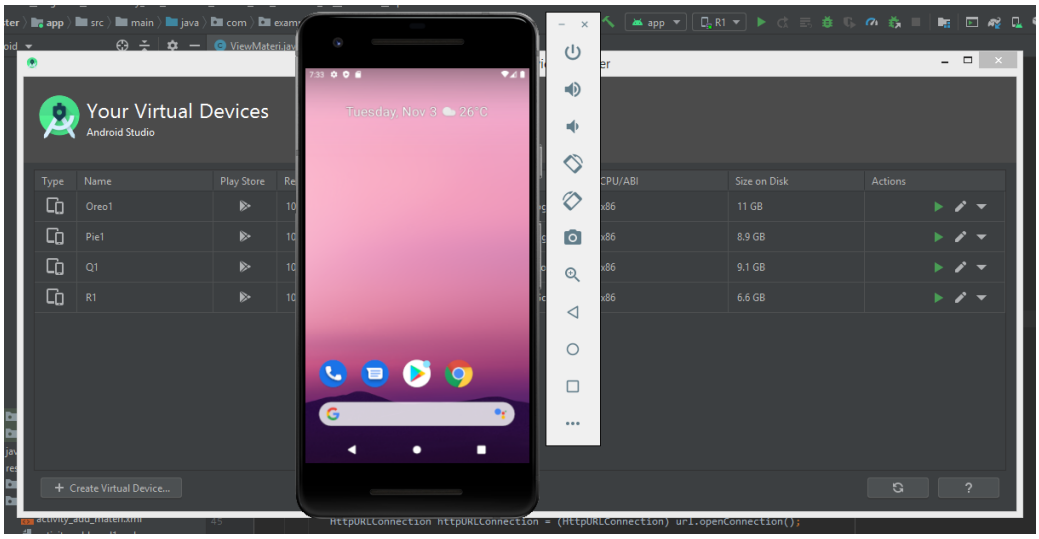

Figure 3 Trial Application for Application Debugging on One Virtual Emulator

Development

The development stage was carried out by making the Android-based learning medium based on the blueprint that was made. The KGD Maternal application was then validated by the midwifery expert and the media expert. The results of the material expert validation showed that the indicators assessed in the material aspect were on the sufficient and good levels, with a total score of 37 and an average score of 3.7. Based on the criteria for interpretation, the materials featured on the KGD Maternal application were considered valid. Meanwhile, the media expert appraised on the sufficient, good, and very good levels, giving a total score of 54 and an average score of 4. In conclusion, the KGD Maternal application was in the very valid category. The KGD Maternal application is described in the following figures:

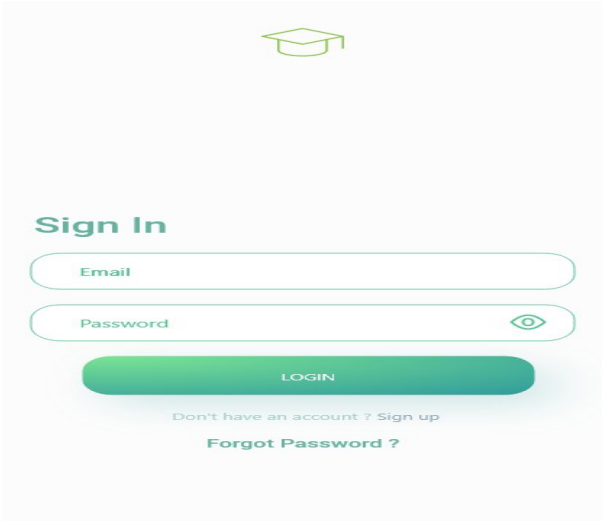

Figure 4 Log In Page

Figure 5 Main Menu Page

The main menu page display as shown in figure 5 presents maternal emergencies materials, video materials, and questions for exercise. This is used as a tool for users of the KGD Maternal application.

Figure 6 A KGD Maternal Application Material Page

The menu, as shown in Figure 6, presents learning materials about maternal and neonatal emergencies, which consist of concepts of maternal and neonatal emergencies, PPH, and the causes and treatments of maternal emergencies.

Figure 7 A Question on a KGD Maternal Application Exercise Page

Implementation

The KGD Maternal application was used in the learning process of the Maternal and Neonatal Emergencies course by 58 students who were willing to become respondents as shown by the informed consent form that they filled out. Fifty-six students filled out the PU and PEOU questionnaires. To find out the distribution of the data, a Kolmogorov-Smirnov test was conducted in the normality testing because the number of respondents exceeded 50. The results showed that the data were not normally distributed because the significance values for both usefulness and ease of use data were < 0.05. Consequently, the data on perceived usefulness (PU) and perceived ease of use (PEOU) were grouped based on the median.

Evaluation

The KGD Maternal application was evaluated by the midwifery expert, media expert, and students using the TAM questionnaires (PU & PEOU questionnaires). The materials on the KGD Maternal application were considered valid and suitable for use. The appearance and ease of use of the application were also assessed by the media expert as very valid. It was suggested by the media expert that the appearance of the materials and the selection buttons on the application should use colors greater in attractiveness and that a "forget password" option should be made available in case a user forgets his/her password while attempting to access the KGD Maternal application. The application can be used as a learning medium on maternal emergencies related to postpartum hemorrhage in the Maternal and Neonatal Emergencies course after being revised following the expert suggestions. Thirty-nine (69.6%) students thought that the KGD Maternal application was useful (median: 45; min score: 34; max score: 55). Fourty-one (73.2%) students thought that the KGD Maternal application was easy to use (median: 39; min score: 28; max score: 55). These data are as shown on Table 1.

Table 1 Percentages of Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) of the KGD Maternal Application (N=56)

PU and PEOU	**Description (N=56)**		
	n	%	**Median (Min-Max)**
Perceived Usefulness (PU)			
a. Useful	39	69.6	45
b. Useless	17	30.4	(34–55)
Perceived Ease of Use (PEOU)			
a. Ease	41	73.2	39
b. Difficult	15	26.8	(28–55)

DISCUSSION

This study developed a learning medium on maternal emergencies related to PPH using the ADDIE (analysis, design, development, implementation, evaluation) model based on Instructional System Desing (ISD).[28] Instructional System Design (ISD) per se is a systematic methodology used for the development of education and training programs with the aim of improving student abilities.[24] One of the advantages of using the ADDIE model is that it can be easily applied to curricula that teach theoretical knowledge, practical skills, and ethics.[29] Several previous studies have also used the ADDIE model in research on the development of learning media, courses, and training programs. Lu et al.[30] used the ADDIE model in developing the Nursing Information System (NIS) training program. The ADDIE model has also been used by Hadi et al.[24] in developing an e-partograph module for midwifery students. The ADDIE model had been used in education development, for example in developing online lecture programs for the capacity building of nurses and midwifes.[31] The development of learning media with the ADDIE model in previous studies has also yielded increases in learning outcomes in midwifery learning and practice.[32,33]

As shown by the validation results, the midwifery expert assessed each indicator as sufficient and good and considered the application valid for the learning of maternal emergencies related to postpartum hemorrhage. In respect to the materials on postpartum hemorrhage, the midwifery expert suggested some improvements so that the materials suit students' needs, in which case it was deemed necessary to make clear of several definitions and descriptions so as not to cause confusion to students when reading the materials. The KGD Maternal application also contains some exercise questions, in relation to which the midwifery expert suggested adding some questions related to shock. There is also a video that explains shock management. The expert stated that the explanation contained in the video can help midwifery students understand the materials better. This is in agreement with the results of the study by Firoozechian et al.[34], which showed that a video learning medium facilitates students' access to materials and provides opportunities for students to re-read the materials several times.

The learning medium KGD Maternal application that concerns with maternal emergencies related to PPH has also been assessed by the media expert, who assessed the indicators in the media aspect on the sufficient, good, and very good levels and concluded that the medium is valid for use. The KGD Maternal application has also been revised according to the suggestions from the media expert, including some improvements to the appearance of the buttons used on the application and the use of more attractive colors. Attractive appearance could increase students' interest in using the KGD Maternal application as a learning medium. This is accordance with previous research, which stated that if educational institutions use learning media such as mobile phones, better results will be obtained.[35] In line with the results of this study, Anderson[36] argued that education does not occur separately and it is the responsibility of each individual to optimize learning opportunities through exploration either face to face or online. Website-based learning media can be another option as learning media that are more accessible to students.[37]

This study shows that the KGD Maternal application was considered useful by students. Midwifery students stated that the KGD Maternal application is useful in the learning process in the Maternal and Neonatal Emergencies course. Some was in an agreement, and some even in a strong agreement, that the KGD Maternal application provides a greater opportunity to access materials about maternal emergencies related to PPH. In support of this study, a previous study states that the use of online learning media enhances midwifery students' learning experience and success in learning.[38] The KGD Maternal application allows midwifery students to understand the materials better. This is consistent with the study by Rahmati et al.[39], that showed the highest increase of understanding in the group of midwives who were trained using mobile applications.

The midwifery students in this study thought that the KGD Maternal application was easy to use as a learning medium on maternal emergencies related to PPH. They stated that the KGD Maternal application provides features which help to access and learn materials on maternal emergencies related to PPH. This was proven by their response that the KGD Maternal application was easy to use due to its flexibility. It was easy to read and access the study materials on maternal emergencies related to PPH on the application. As emphasized by some previous studies, applications and websites are easily accessible media and are useful sources in the learning process.[37,40] The study by Khoiriyah et al.[41] confirmed that modules that are presented in applications are easy to learn and access anywhere. The ease of

using technology-based learning media had also been confirmed by previous studies by Brown and McCrorie[42] as well as Baghcheghi et al.[43]

Smartphone technology encourages students to study independently and mobilize supporting resources.[40] The research by Chipps et al.[35] concluded that educational institutions should support the use of mobile phones appropriately and systematically in the learning process. Modern curricula will be better if they involve the use of applications, mobile-learning devices, and technology in the learning process.[42,44-45]

CONCLUSION

The ADDIE instruction model was considered an appropriate model for developing mobile applications as learning media. The KGD Maternal application was found to be an effective learning medium for learning maternal emergencies for midwifery students. This study was through validation by midwifery and media experts. The usefulness and convenience of the KGD Maternal application were confirmed by the students. The students also gained more understanding of maternal emergencies related to PPH through the KGD Maternal application. The application was an easily accessible medium and a useful source in the learning process as confirmed by midwifery students' rating the KGD Maternal application as useful in the learning of maternal emergencies (69.6%) and easy to use in the teaching and learning process (73.2%). Therefore, it is suggested that institutions of midwifery and nursing education should use mobile applications in order to provide easily accessible learning media.

RECOMMENDATIONS

Nursing and midwifery instructors can use the KGD Maternal application as a learning medium in Maternal and Neonatal Emergencies since it is considered an easily accessible learning medium. It is recommended by the researcher that nurses and midwives at public health centers should use this application to increase their understanding and knowledge of maternal emergencies as a medium easy to access at any time. Further research is needed to improve this application and allow it to be smoother in use. It is also suggested to use learning materials that cover all the needs in maternal emergencies courses.

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