Research Paper:
Prehospital Trauma Management: Evaluation of a New Designed Smartphone Application Abstract

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ABSTRACT

Background: Regarding the undeniable role of nurses in caring for patients with trauma, a suitable method is required for the education of nursing students to meet their needs. In this study, first we designed an educational smartphone application for pre-hospital trauma management and then nursing students evaluated its usefulness.

Methods: This applied study has a cross-sectional design and conducted to develop a mobile application. A total of 41 undergraduate nursing students participated in this study. They were selected through the census method from Iran University of Medical Sciences in 2018. The educational content of the application was developed based on the available standard skills required for prehospital trauma management. The study sample first received routine education. Then they used the application to handle and manage care for traumatic patients for one month. The students' satisfaction with the application was measured using a software called application satisfaction questionnaire. The obtained data were analyzed by descriptive statistics in SPSS V. 21.

Results: After designing the application, 97.6% of the students reported that the classification of data in the application was appropriate. From their point of view (92.7%), the application also provided the required information for the appropriate patient's care in trauma situations. All students reported that the application, its links to web pages, movies, texts, and images were easy to use. About 95% of the students reported that graphic components, colors, and moving between pages were easy. Most were satisfied with the application and recommended its use to other undergraduate nursing students. The majority of them (80.5%) used the application consistently and suggested (80.5%) that the same application should be prepared for other courses.

Conclusion: The application was reported to be easy to use for trauma management and students were generally satisfied. Therefore, it can be used to facilitate the educational process and help students learn at any time and place.

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Highlights

- Nurses have an essential role in caring for patients with trauma and their education in this regard is essential.
- For this purpose, we designed an educational smartphone application for pre-hospital trauma management.
- Our study sample used the application to handle and care for traumatic patients for one month.
- Most nurses were satisfied with the classification of data in the application, and its appropriate information.
- This kind of educational applications facilitates the educational process and helps nursing students.

Plain Language Summary

Nurses have an essential role in caring for patients with trauma, so a suitable method is required for the education of nursing students in this regard. We designed an educational smartphone application for pre-hospital trauma management and asked nursing students to evaluate its usefulness. The educational content of the application was prepared based on the available standard skills required for prehospital trauma management. The study sample first received routine education, and then they used the application to handle and care for traumatic patients for one month. Based on the results, most nurses were satisfied with the classification of data in the application, and the information was appropriate for the patient's care in trauma situations. In addition, all students reported that the application, its links to web pages, movies, texts, and images were handy. The majority of them used the application consistently and suggested that the same application should be prepared for other courses. Thus, the application was easy to use for trauma management, facilitated the educational process, and helped nursing students.

1. Background

Trauma is one of the major causes of death in people aged under 46 years in the United States (Rees et al. 2015), Japan (Nagata et al. 2018), and South Africa (Moller et al. 2018). The quality of care for patients with trauma affects their survival rate (Dijkink et al. 2018). Appropriate education can help students identify threats to patient's safety in trauma situations (Cohen et al. 2018). In the 21st century, nursing education relies on educational technology (Coombs 2018).

Education for trauma situations includes the use of conceptual and graphic maps, simulation on mannequins, workshops, lectures, and videos; each of these tools has its own advantages and disadvantages (Gilavand & Hosseinpour 2015). The new generation of students has accepted Information Technology (IT) as an important part of their social and educational life (Padilha et al. 2018).

Some smartphone-based apps are designed to improve learning in higher education (Farshida et al. 2018). In nursing education, the smartphone-based educational application is a feasible way to improve students' learning and their clinical skills (Kim & Suh 2018). Students and nursing instructors have positive attitudes toward this innovative educational method and are keen to use it (Hay Benjamin et al. 2017). Nowadays, nursing students spend most of their time on the use of a mobile device, that can increase their knowledge level (Hsu et al. 2018; Qiu & Mcdougall, 2013). Using smartphones can facilitate learning and reduce students' fear of the clinical environment (Kek & Huijser 2017). Mobile phone applications have been used to teach basic nursing concepts, functional and long-term skills, as well as maternity care (Chang et al. 2018). There is more satisfaction with the use of this method compared to traditional teaching methods among nursing students (Lee et al. 2018).

The advantages of this application include easy access to textbooks, charts, images, and movies without a need to carry a large number of papers (Bolliger & Shepherd 2018). Flexibility, accessibility, usability, and diversity of mobile technology make the application more attractive and useful (Bano et al. 2018). Instructors use educational applications as an effective tool for long-term learning of nursing students (Wayne & Ritvo 2014).

This application can promote clinical skills and satisfaction with learning among nursing students (Kim

& Suh 2018). Also, it can increase the quality of care and patient's safety (Grabowsky 2015). The use of this application has led to the development of self-esteem and skills and, consequently, satisfaction with learning among nursing students (Gallegos & Nakashima 2018).

This method improves students' self-efficacy, clinical skills, and satisfaction with learning (Jeong 2017). This educational method can improve students' attitude towards learning methods and can be an effective way to learn clinical skills (Pourteimour et al. 2018). The use of the application in nursing in Iran has been associated with the improved satisfaction of students and nurses and has reduced their errors along with the improvement of patient's care (Mazlom & Rajab Poor 2014).

Healthcare professionals are still uncertain about the effectiveness of educational applications in terms of their quality of program content, usability, matching with the standards of public health and general users, as well as the program security and privacy (Boulos et al. 2014).

The role of smartphones in medical and nursing education is promising and attractive, but more quality studies are required to identify its role in education (Ozdalga et al. 2012). Considering the importance of students' preparation for traumatic situations, improving their quality of care, and safety of patients, in this study, we designed an educational smartphone application for prehospital trauma management and nursing students evaluated its usefulness.

2. Materials and Methods

Research design

This cross-sectional and applied study was conducted on 41 undergraduate nursing students who were selected by the census method from Iran University of Medical Sciences in 2018. The research had two parts; designing a smartphone application and students' evaluation of the application.

The educational content of the application

The educational content of the application was designed under the Android operating system and included 9 nursing care skills of patients with trauma. The content was designed based on library resources. At the beginning of each part of the educational content, the importance of care in and procedures related to trauma situations were explained. Also, the relevant images, video clips, and texts were laid out for step-by-step education of each skill. An expert panel confirmed the validity of the educational content. Next, the educational content was used for education.

Creating the application prototype

The application was designed in collaboration with a programming engineer to support at least the Android 5th version application, and for online use of downloading educational contents and videos. A guide on how to use the application was devised and each user could easily log into the application and use the educational content. The application was used to create the 2.3 version studio framework. The user must first register the application on the registration page. The data were recorded in a server (Windows server 2012) as a database. The texts were included as an HTML file.

The application had features including color settings and zooming on the content. Users could use their own passwords to login into and install the application. The number of application usage was recorded. First, a general design was made, and then various parts were added to it. Different sections of the application are shown in Figure 1.

At each stage of the application development, it was evaluated by a panel of experts and 10 students who were not included as the study sample. Their comments were collected through an interview following a one-hour use of the application and were applied to the final version. They talked about the simplicity of its use and ambiguities in the interview schedule; so the final corrections were made to the program. After designing the application, it was provided to three programmers, and its applicability and usability were examined. Lastly, the final version of the smartphone-based application was used in this research.

Study Sample The participants were undergraduate nursing students in their 7th semester of education. The inclusion criteria were achieving a minimum score of 12 in the Emergency Nursing course and having an Android smartphone. Of 53 students surveyed, 3 were unwilling to take part in the study, 4 did not have an Android smartphone, and 5 students did not successfully pass the theoretical course. Finally, 41 students were enrolled in the research.

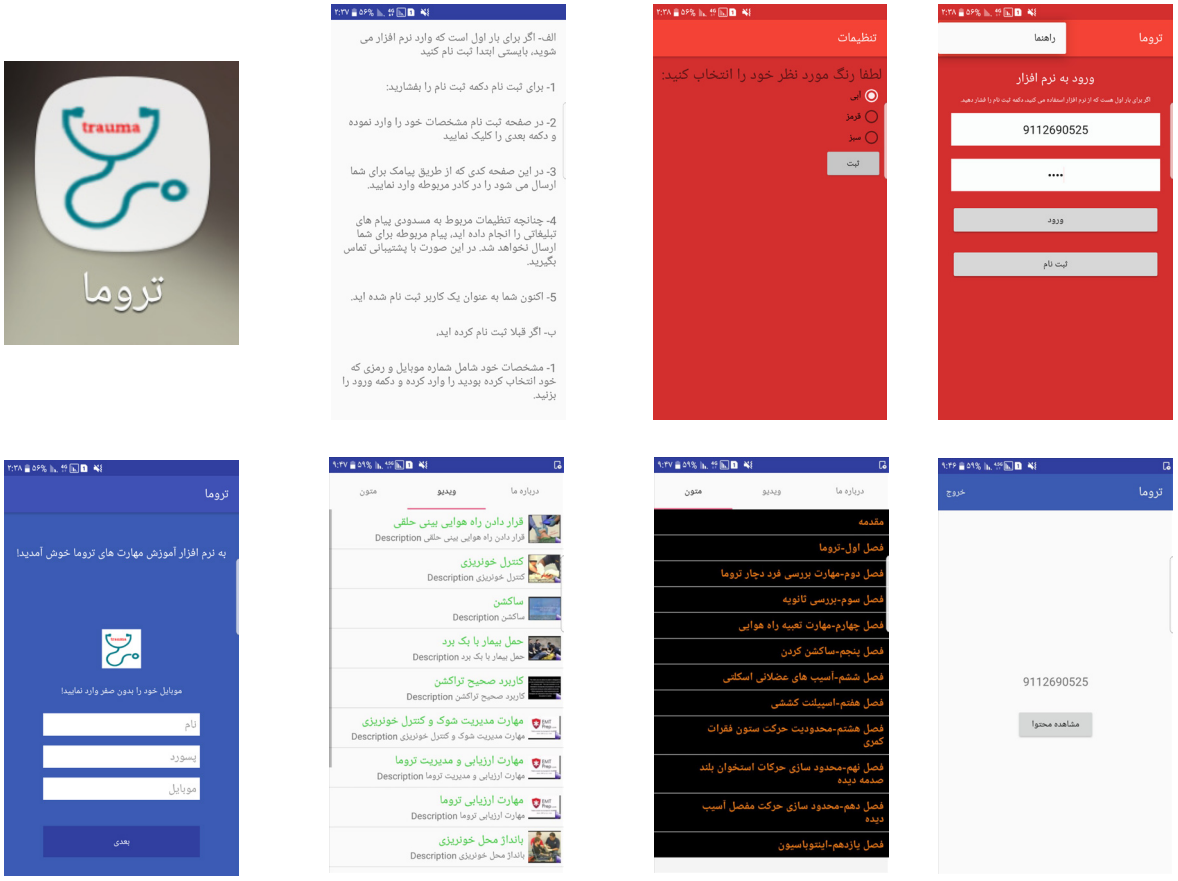

Figure 1. Different sections of the application

Client- Centered Nursing Care

Data collection

For data collection, a demographic data sheet and software assessment questionnaire were used. A self-administered demographic data sheet was designed. It was completed by the students before using the application. The software assessment questionnaire (Ghazisaeedi et al. 2015) was used for data collection. This is a researcher-made questionnaire which its validity has been confirmed by experts in the field of Technology and Health Information Management and its Cronbach's α coefficient was 0.85. The questionnaire consisted of 30 questions, including "Content and appearance" (8 questions with Likert-type scale scoring consisted of "I completely agree", "No idea", and "I completely disagree" responses); "simplicity and ease of use" (5 questions).

It had two general questions on software evaluation on a Likert-Type Scale from very high to very low and ten questions with yes/no responses to assess the educational software aspect. Five open-ended questions were available to evaluate the useful and non-useful aspects of the software, its positive and negative points, and related suggestions. It was a self-report questionnaire that was completed by the students after using the application for one month. The questionnaire was modified according to the requirements of the present study and its validity was assessed by a panel of experts. To evaluate its reliability, 10 students that were not included in the main study, completed the questionnaire and its internal consistency was assessed and reported as 0.80.

Study procedure

After designing the application, all study students were educated about how to install and use the application in a 30-min session. During this session, their questions were answered and they were asked to fill out the demographic form. A virtual telegram group was created for the students and an application installation link was placed there. In this group, the installation method was also fully explained to the students and their questions were answered. It was ensured that students were succeeded in installing and using the application. This application was available for the students for one month. Then the software assessment questionnaire was completed by the students.

Data analysis

The obtained data were analyzed by descriptive statistics (frequency and percentage) in SPSS V. 16.

3. Results

In this research, undergraduate nursing students participated (Table 1). The results of the students' satisfaction with the educational application showed that 97.6% of them rated the information classification in the application as appropriate. About 92.7% of them said that the application fonts were legible, appropriate, clear, transparent, and without distortion, also the application met their information needs for the management of trauma patients properly.

All of the users found the links to the web pages in the application useful and the images made learning easier. Graphic components and colors were reported by 95.1% of the students as appropriate. Also, 82.9% of the students stated that it was easy to move back and forward in the application. All of the students stated that the application was simple to use and 97.6% of them reported that it was easy to learn using the application. All of the students considered that images of the application were suitable for simplifying the learning process and 92.7% of them were generally satisfied with the application and recommended its use to other undergraduate nursing students (Table 2).

Most of the students (82.9%) stated that it was possible to learn the content of patient management in trauma situation using the application. Also, 87.8% of the students used this information to take care of traumatized patients in practice (Table 3). The majority of the students received answers to their questions about traumatic issues and mechanisms (87.8%), limitation of joint motion (97.6%), and intubation (92.7%). All of them found answers to their questions about the aspects of trauma management, airway deployment, bleeding control, and shock therapy, use of tension splint, restricting the spinal cord in both sitting and supine positions, and restricting damaged chest bones (Table 4).

Table 1. Demographic characteristics of the students (n=41)

Variable		No. (%)
Age (y)	20-21	10(24.4)
	22-23	26(63.4)
	≥24	5(12.2)
	Mean±SD	22.36±1.49
Gender	Female	24(58.5)
	Male	17(41.5)
Smartphone-based education	Yes	7(17.1)
	No	34(82.9)
Work experience in the emergency department	Yes	3(7.3)
	No	38(92.7)
Work experience in the hospital	Yes	29(70.7)
	No	12(29.3)
Previous education on trauma	Yes	7(17.1)
	No	34 (82.9)
Course score	Mean±SD	115.73±7.62
Theoretical score in medical emergency course	Mean±SD	17.81±1.05

The data are presented as No. (%) or Mean±SD.

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Table 2. Content, appearance, ease, and simplicity of using the smartphone application for trauma management (n=41)

Application Evaluation Topic	Variables	I Completely Agree	No idea	I Completely Disagree
		No. (%)	No. (%)	No. (%)
Content and appearance	The information presented in the application is well-classified.	35(97.6)	5(12.2)	1(2.4)
	The application meets my information needs in relation to the correct methods of caring for a traumatic person.	38(92.7)	3(7.3)	0(0.0)
	The links to web pages added to some parts of the application for more information were useful.	41(100.0)	0(0.0)	0(0.0)
	Moving between the pages is easy.	34(82.9)	3(7.3)	4(9.8)
	Graphic components, buttons, and colors used in the application are suitable.	39(95.1)	2(4.9)	0(0.0)
	Design of the application pages is clear, transparent and without distortion.	38(92.7)	2(4.9)	1(2.4)
	Images in the application make it easier to learn.	41(100.0)	0(0.0)	0(0.0)
	Fonts used in the text were legible.	38(92.7)	3(7.3)	0(0.0)
Ease and simplicity of use	Use of this application is easy.	41(100.0)	0(0.0)	0(0.0)
	It is possible to learn better and more easily through this application.	40(97.6)	1(2.4)	0(0.0)
	Information and explanations in the application are easy to understand.	40(97.6)	1(2.4)	0(0.0)
	Images in the application make it easier to learn.	38(92.7)	3(7.3)	0(0.0)
	Overall, I am pleased with the application and I recommend using it to other undergraduate nursing students.	38(92.7)	3(7.3)	0(0.0)

Data are presented as No. (%).

The students also responded to an open-ended question regarding the best features of the application. All students expressed that the texts and videos were useful parts of the application. They did not report any inconsistencies in the educational content. Only 9.8% and 4.9% of the students respectively reported that password and internet disconnections were the application problems.

The necessity to be online (17.10%) and the separation of movies from the text (7.30%) were the negative aspects of the application, while 75.60% of the students did not report any negative aspect. The most suitable features of the software in terms of students' application were its comprehensive content (17.10%), easy to use (7.30), appropriate videos and images (15.50), and good accessibility (17.10). The students stated that all aspects of the application were useful (34.10%). The majority of students (80.50%) suggested that the application should be designed for other courses.

4. Discussion

The students were satisfied with the application. They expressed the simplicity and ease of using the educational content, the novelty of this educational method, and the comprehensive content of videos, images, and texts. They used it to learn how to deal with a patient in

Table 3. Updates and practical use of the application for trauma management (n=41)

Evaluation topics	Variables	No. (%)		
		Very Much	Many	Medium
Being updated and its application in the practical implementation of skills	How much the application did you use to learn new content?	34(82.9)	4(9.8)	3(7.3)
	How much information about the application did you use in practice when taking care of a traumatic patient?	36(87.8)	5(12.2)	0(0.0)

Data are presented as No. (%).

Table 4. The application use for trauma management and meeting students' learning needs (n=41)

Evaluation Topics	Variables	Yes	No
		No. (%)	
Continuous use of the application	Did you use the application continuously?	33(80.5)	8(19.5)
Accountability of educational content of the application to students' learning needs	Trauma and its mechanism	36(87.8)	5(12.2)
	Skill assessment and management of a person with trauma	41(100.0)	0(0.0)
	Oxygenation and sectioning skills	41(100.0)	0(0.0)
	Bleeding management skills and shock therapy	41(100.0)	0(0.0)
	The skill of using tension splint	41(100.0)	0(0.0)
	Restricting the spinal cord in the sitting position	41(100.0)	0(0.0)
	Restricting damaged chest bones	41(100.0)	0(0.0)
	Damaged joint limitation skill	40(97.6)	1(2.4)
	Intubation skill	38(92.7)	3(7.3)

Data are presented as No. (%).

Client- Centered Nursing Care

trauma situations. The students were interested to have access to this information at any time and place. Portability, easy entry and exit, ease of reading and recording are the most important factors for the use of such educational programs by students (Li et al. 2018).

The results of this study were in line with some other studies on the education of students about the use of the smartphone application. Master degree nursing students in a study preferred digital learning resources, especially smartphone applications (Long 2018), and nurses were comfortable with the use of this application (Carter-Templeton et al. 2018). In another research, nursing students evaluated the smartphone-based infusion pump education program as a desirable educational tool (Quattromani et al. 2018). Another research showed that the use of smartphone application increased self-efficacy, clinical skills, and satisfaction of nursing students (Chuang et al. 2018). Students' perceptions of the ease and usefulness of e-learning were appropriate and they were willing to learn using this method due to the easiness and usefulness of the application (Salari et al. 2009).

The limitation of the research was the lack of access of all students to the Android smartphone, which reduced the sample size. Accordingly, a study with larger sample size is recommended. The same program is suggested to be used in other operating systems and its quality should be evaluated. The application was not designed in an interactive method. There is a need for an interactive application using a question and answer method for interaction between the educator and the learner.

This study showed that nursing students were satisfied with the application of prehospital trauma patients. Because nurses are often the first responders in clinical emergencies, nursing students and nurses require regular, periodic, and accessible training on trauma management using mobile application along with traditional methods. By using this application, nursing instructors and also the hospital and nursing managers can use this attractive and acceptable method to teach nursing students and nurses and improve their competencies and skills in trauma management.

Ethical Considerations

Compliance with ethical guidelines

The study was conducted after approval of the Ethics Committee of Iran University of Medical Sciences (code: IR.IUMS.REC1396.9511706001). The researcher presented a detailed description of the research aim and process to the students. If they were willing to

participate in the research, they were asked to sign a written informed consent.

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Authors' contributions

Data collection: Fateme Taziki Balajelini; Data analysis, manuscript drafting: Fateme Taziki Balajelini, Tahereh Najafi Ghezeljeh; and Study supervision: Tahereh Najafi Ghezeljeh.

Conflict of interest

The authors declared no conflict of interest.

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