



The impact of airway management training by utilizing smartphone on the learning of undergraduate medical students

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Abstract

Introduction: Smartphone-based learning is a novel learning technique in medical education. Smartphones have good potentialities to be used as a learning tool for their wide application among students. The aim of this study was to investigate the impact of training airway management by utilizing smartphones on the learning of undergraduate medical students.

Methods: In this semi-experimental study, it was tried to intervene in the students' way of learning by using smartphone training application. The participants included 120 undergraduate medical students of School of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran. Forty students were randomly selected and divided into two groups of control and experimental. Then, teaching through two methods of traditional method (face to face) and combined method (traditional + smartphone-based software) was performed for control and experimental groups, respectively. After that the teaching was finished, the level of knowledge and practical skills of both groups were evaluated. Students' practical skills were assessed using a standard checklist on the moulage. The knowledge score was obtained using a multiple-choice written test. Finally, data were analyzed by SPSS software using independent samples t-test.

Results: There was a significant difference between the mean score of knowledge and practical skills of the experimental group when compared to the controls ($P < 0.05$) and the smartphone application was efficient in improving student learning.

Conclusion: Utilizing smartphone application can be a complementary method for traditional education in enhancing medical skills. Accordingly, the use of blended training in medical education is suggested.

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Introduction

Every deed of man is the result of learning. Learning is a partially stable change in the behavior which is derived from experience.¹ The new educational approaches emphasize individual learning which of course does not happen in classroom's limitations.² Constructivist theory is one of the new approaches of learning which has fundamental implications for medical education.³ The importance of using this approach and its teaching methods for medical education is explicit. The reason

behind that is the nature of medical sciences which increases the need for such an approach according to the position and working with authentic cases.⁴ There are three traditional, virtual, and combined learning methods. The basis of the traditional learning method is the provided information by the teacher and its learning through listening and taking notes from the inclusive one.¹ Virtual education focuses on the transmission of content through electronic environments and includes two generations of correspondents (using postal systems) and

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e-mail [using the Internet, intranets, and mobile-learning (m-learning) tools]. Combined learning is a mixture of traditional and virtual methods.⁵ One of the most important reasons to use virtual learning in medical education system is that the learner is responsible for learning in this method.⁶

Researchers such as Dehghanzadeh and Jafaraghae,⁷ Roohi et al.,⁸ Mohammadi et al.,⁹ Zaraii Zavarki and Toofaninejad,¹⁰ Mohammadimehr and Taghipour,¹¹ Ahmady and Nakhostin-Ruhi,¹² Sadeghi et al.,¹³ Mafyan et al.,¹⁴ Kraut et al.,¹⁵ McCutcheon et al.,¹⁶ Smith,¹⁷ and Acelajado¹⁸ believed that the blended training was more effective than separate electronic and traditional methods.

Considering the tremendous progresses in information technology (IT), educational systems have to use IT-based approaches to maintain their survival and dynamism.¹⁹ Mere classrooms setting and using conventional methods cannot transfer knowledge in the appropriate manner.² Smartphone is a tool for individual learning, and for its widespread application among students, in addition to providing student-centered learning, accelerates the updating of educational content and reduces financial and human costs.^{20,21}

Medical education plays a role in realizing the sustained development of the health system of a country. New fields of medical sciences and innovations in the field of modern medical technology and educational technologies are rapidly developing and spreading.²² Due to the high workload in educational hospitals, traditional teaching methods seem not to be the proper ways of learning and are not responsive to the increasing demand for learning. Enhancing the responsibility of clinical instructors reduces their students' educational opportunities and this passive learning in clinical environments leads to the early forgetting of the lessons learned.^{23,24} One of the options is to fill the educational gap using modern technology and blended training.²⁵

Being skillful in airway management reduces the risk of irreversible complications

in the patient's key organs. These skills include understanding the concepts and principles related to airway management technique among patients.²⁶⁻²⁹ Although a high percentage of accidents among injured people are caused by airway problems, in more than 80% of cases, students have poor performance on patient's bedside.³⁰ So, learning how to manage airway in a proper manner is of particular importance. The necessity of using electronic learning (e-learning) tools becomes more highlighted when we consider ethical issues, patients' rights, traditional teaching methods challenges, and high amount of educational content.

Given the rapid changes in medical knowledge and the increased demand for learning, the use of new e-learning opportunities is responsive to the needs and challenges of medical education.^{31,32} In the studies by Khatooni et al.,³³ Chase et al.,³⁴ and Gormley et al.,³⁵ the efficacy of e-learning software on students learning and skills has been shown. Fernandez-Lao et al.,³⁶ Briz-Ponce et al.,³⁷ Noohi et al.,³⁸ Fozdar and Kumar,³⁹ Moradi and Didehban,⁴⁰ Babazadeh-Kamangar et al.,⁴¹ and Naderi et al.,⁴² it was suggested that the use of smartphone in medical education had positive impact on student learning.

Clinical skills training centers have good potentials in conducting research on effective learning methods. Therefore, the present study was carried out at Clinical Skills Center of School of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran, with the aim of investigating the impact of airway management training by utilizing smartphone on the learning of undergraduate medical students.

Methods

In this semi-experimental study, the researcher intervened in the learning skills of airway management by utilizing smartphone educational software and evaluated its impact on students' knowledge and skills. At first, an educational expert (researcher) of the Clinical Skills Center, based on the

educational curriculum of undergraduate medical students and by consulting with the professors, compiled the educational content and then the software was designed and was coded by a software engineer. The designed software was tested by project manager, software engineer, experts, and professors at the center (it was validated and verified). The main topics of the software were: airway assessment methods, types of maneuvers in airway management, advanced procedures for establishing an airway in the patient, familiarization with airway management tools, and familiarization with routine drugs of airway management. In order to assess the validity of the software, content validity was used by 10 emergency medical and anesthetist experts and content validity ratio (CVR) and content validity index (CVI) were calculated to be 0.81 and 0.84, respectively.

The statistical population of this study was medical students of School of Medicine of Tabriz University of Medical Sciences. Forty students were selected by simple random sampling and were randomly assigned into two groups of control and experimental. For ethical considerations, the consent was taken from the students, and it remained free to leave the study at any stage. Students had not already been familiar with the airway management, therefore, it was not logical to conduct a pre-test, and the post-test experimental design (with control and intervention groups) was implemented.

Both control and intervention groups participated in the research setting (Clinical Skills Center), while the control group was taught by traditional method (lecture + practical exercises on the moulage) and the intervention group was trained using combined method (traditional + educational software). Two weeks before the presence of the intervention group in the research environment, they were provided with the educational software. Immediately at the end of the training, cognitive knowledge was assessed using a multiple-choice academic achievement test and practical skills by Objective-Structured Clinical Examination

(OSCE) test using a checklist approved by the Ministry of Health and Medical Education.

The validity of the questionnaire of cognitive knowledge test was confirmed by faculty members of Clinical Skills Center using face validity method. To evaluate its reliability, the peer-to-peer test method was used. In a way that designed test was implemented parallel to the test designed by Morteza-Bagi and Rafati⁴³ (with thesis number of 10210101942018-2016). The results of pilot study on 30 respondents showed a correlation coefficient of 0.82 between two parallel questionnaires. It was confirmed that the designed data collection tools had acceptable validity and reliability. In approving the validity and reliability of the practical skill assessment tool, the standard checklist of the Ministry of Health and Medical Education was utilized. The cognitive knowledge questionnaire included 11 multiple-choice questions of 4 options designed by faculty members which measured cognitive knowledge with a score range of 0 to 11. The "I do not know" choice is also used to avoid fluky answers. The practical skill scores ranged from 0 to 20. Both groups were asked to answer cognitive knowledge questions and to demonstrate their skills in intubation and foreign body aspiration management on educational moulage. The demographic characteristics of students including gender, marital status, age, and the status of their use of mobile-based educational software (usage, accessibility, and satisfaction level) were questioned.

After data extraction, descriptive statistics [mean \pm standard deviation (SD)] and independent t-test were used to compare the means in SPSS software (version 24, IBM Corporation, Armonk, NY, USA). In this research, the significance level was considered to be < 0.05 .

Results

In this study, 60% of the subjects were women and 95% were single. The average age was 22.59 ± 1.14 . 75% of students did not use Mobile Educational Services Application (MES app).

Table 1. Status of the use of mobile educational services application (MES app) in research samples

Variable	Ranking	Percentage
The amount of MES usage	Zero	75.0
	Very little	5.0
	Low	5.0
	Medium	15.0
	Much	0
	Very much	0
Access to software method	Sites and social networks	55.6
	Friends	44.4
	Professors	0
Software cost	Very little	75.0
	Low	16.7
	Medium	0
	Much	8.3
	Very much	0
Satisfaction with the amount of access to educational software	Very little	26.3
	Low	15.8
	Medium	52.6
	Much	0
	Very much	5.3
The cause of dissatisfaction with the rate of use for software	Little time to study	20.0
	Lack of access and awareness	46.7
	Expensive cost	3.3
	Lack of proper software	30.0
Satisfaction with the university for the provision of software	Very little	65.0
	Low	12.5
	Medium	12.5
	Much	7.5
	Very much	2.5

MES: Mobile educational services

55.6% of the students who used MES app in their learning had access to software through websites and social media networks, and professors did not play any role in this regard. The cost of providing software in 75% of the students was very low. Satisfaction of students with access to MES app was moderate and 46.7% of students expressed their dissatisfaction with "lack of access to and knowledge of this software". The satisfaction from the university in providing the facilities for using MES was very low in

65% of the students (Table 1).

The mean scores of cognitive knowledge in the control and experimental groups were 4.84 ± 1.30 and 7.00 ± 1.89 , respectively, with a score range of 0 to 11, which showed a significant difference ($P < 0.001$). The mean scores for management of foreign body aspiration and tracheal intubation in the control and experimental groups were 25.72 ± 11.10 and 34.85 ± 5.14 , respectively, with a score range of 0 to 40. Here, the difference was also significant ($P = 0.002$) (Table 2).

Table 2. Comparison of mean scores of cognitive knowledge and practical skill in both control and intervention groups (after training)

The dependent variable	Control	Intervention	T	P	df
	Mean \pm SD	Mean \pm SD			
Knowledge	04.84 ± 1.30	7.00 ± 1.89	-4.12	< 0.001	38
Practical skill	25.72 ± 11.10	34.80 ± 5.14	-3.31	0.002	38

df: Degree of freedom; SD: Standard deviation

Discussion

Prevention of irreversible complications in injured patients is possible by improvements in learning airway management skills. Smartphone as an e-book is an effective tool in learning. Planning to improve the culture of its utilization among professors and students seems to be an important issue. Therefore, the present study tried to investigate the effect of airway management training by utilizing smartphones on the learning of undergraduate medical students.

The results showed that training with smartphone significantly affects students' cognitive and practical skills scores and can be used as a complementary method for traditional techniques. Therefore, medical education planners need to use smartphone to provide deep learning and reduce human and financial costs. This finding that the experimental group had higher mean scores, when compared to the control group, indicates that the smartphone improves the student's readiness to attend workshop and improves content realization by pushing the student toward individual learning.

Babazadeh-Kamangar et al.⁴¹ in their research showed that using smartphone prior to attending a pathology classroom increased student readiness and thus improved learning. This finding was consistent with the results of the present study. A research by Noohi et al.³⁸ showed that learning with smartphones led to the reduction of medical errors in nursing students, which is consistent with the present study. The research by Ahmady and Nakhostin-Ruhi¹² showed that combined learning was more effective than traditional and electronic methods. This was also parallel to our study. Fozdar and Kumar³⁹ and Naderi et al.⁴² in their researches showed that learning with smartphone had a positive effect on the memory and readiness of students to learn clinical skills. Mohammadi and Shafeian concluded that smartphone educational software was the most effective educational tool according to the medical students. The main reason for this was that education

became student-centered and attractive through smartphone education.⁴⁴ In a study by Ebrahimi et al., the positive features of smartphone were mentioned as: easy handling, facilitating content reminding, and availability that can overcome the limitations of the traditional method.⁴⁵ The effective factors in the efficacy of smartphone apps in student learning in this research was the student-centeredness, individuality of learning, every day and everywhere use, the provision of appropriate educational materials, and the attractiveness of mobile-based learning environments.

This study has some limitations: the first limitation is that clinical training managers in hospitals do not provide sufficient support in terms of the regular presence of students and professors in clinical centers and the use of educational facilities. Therefore, it is recommended to improve the status of these centers in the curriculum of general medicine course. More studies with bigger sample sizes on the effectiveness of educational software can improve the culture of utilizing effective tools for learning among professors and students.

Another limitation is the low motivation of professors to develop educational content for smartphone apps. Using experts who are specialized in content writing and conducting extensive studies on the effectiveness of new methods of learning can enhance the motivation of faculty and eliminate the time barriers in producing software and educational content.

Conclusion

The results of the present study indicate that the use of smartphone as an e-learning tool is effective in removing many barriers of traditional teaching methods, especially financial, time, place, and manpower constraints. Therefore, more emphasis on designing mobile-based e-environments and its impact on learning seems to be a fundamental issue. Accordingly, the development of virtual education along with face-to-face training, development of virtual

education networks,⁴⁶ creation of social networking mobile education, production of electronic content along with the content of classes, the establishment of educational chat rooms, and the simultaneous interaction of traditional education with e-learning and using blended training can have significant positive outcomes.⁴⁷

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Authors' Contribution

All of the authors contributed equally.

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Conflict of Interest

Authors have no conflict of interest.

Ethical Approval

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