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Research Article

Comparison of Electronic Learning Versus Discussion-Based Learning Methods on Learning Rate of Medical Students about Sedation in the Emergency Room: An Analytical Descriptive Prospective Study

Aidin Zeinaly[1], Afsaneh Mouseli Kelvanagh[2], Maryam Soleimanpour[3], Robab Mehdizadeh Esfanjani[4], Hassan Soleimanpour[5]*

[1]*Department of Anesthesiology and Critical Care, Urmia University of Medical Sciences, Urmia, Iran.*

[2]*Students Research Committee, Tabriz University of Medical Sciences, Tabriz, Iran.*

[3]*Clinical Research Development Unit of Tabriz Valiasr Hospital, Tabriz University of Medical Sciences, Tabriz, Iran.*

[4]*Neurosciences Research Center, Tabriz University of Medical Sciences, Tabriz, Iran.*

[5]*Emergency and Trauma Care Research Center, Tabriz University of Medical Sciences, Tabriz, Iran.*

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ABSTRACT

Background: The aim of the present study was to compare the effectiveness of two teaching models (e-learning and discussion-based learning) on the learning process of emergency department interns in relation to the use of the sedatives.

Methods: In this study, 129 interns introduced to the emergency medicine department were included in the study. These interns were randomly divided into two groups, I and II. For both groups, a pre-test based on standard parallel multiple-choice questions (MCQs) was prepared. Then, the electronic software which was prepared was distributed to the first group. For people of group II, six hours of discussion-based training was conducted for 3 consecutive weeks. At the end of the course (after 1 month), a post-test, which was the same questions as the pre-test, was obtained from interns in both groups.

Results: At the end of the study, we found a significant improvement in the learning rate of both groups all aspects of the knowledge including: science related to the use of narcotics in sedation (P=0.01 for e-learning group and P<0.001 for discussion based group), knowledge related to the use of intravenous anesthetics for sedation(P=0.025 for e-learning group P<0.001 for discussion based group), Knowledge related to definition and clinical judgments in sedation and Knowledge related to the use of Neuromuscular blocking agents (NMBAs) for sedation (P<0.001 for both groups). However, for all the investigated results, the learning rate was significantly better in the discussion-based learning group compared to the e-learning group (P<0.001).

Conclusion: According to the results of this study, we found using either e-learning or discussion-based learning methods increase the acquisition of sedation knowledge for emergency department students. However, the discussion-based method have better results on the learning process of the interns.

The authors declare no conflicts of interest.
*Corresponding author.
E-mail address: h.soleimanpour@gmail.com

Introduction

Educational systems in the world have witnessed extensive changes during the last few decades. In traditional educational systems in universities and schools, education is basically based on professor teaching and is still one of the common approaches, especially in developing countries [1-2]. Following the rapid growth of information and communication technology, traditional teaching methods singly is not sufficient for the educational needs of today's societies. However, until 2019, the application of new methods in educational systems of developed or developing countries had not yet spread well and many educational centers were using traditional techniques and approaches [3]. With the outbreak of the COVID-19 pandemic, many educational centers and universities in the world closed for months, and in order to prevent the spread of this viral disease, they have considered alternative methods for teaching. As a result, all nations implemented lockdown procedures forced educational institutions to look for novel educational plans without risking the health of their students and faculty [4-5].

With all the unpleasant consequences that this pandemic caused in the world such as the death of many people in different countries; the COVID-19 tragedy forced the educational systems to consider the electronic methods in the educational process and provide the necessary facilities for this approach. In Iran's educational system, with the prevalence of the COVID-19 pandemic, all educational processes in schools and universities were held completely electronically for almost two years and after the reduction of the incidence of this disease, mixed methods were used [6-8]. Although several studies, including a meta-analysis, have pointed to the positive outcomes of online education (e-Learning) [8-9], there are still barriers in this field, including time constraints, poor technical skills, inadequate infrastructure, absence of institutional strategies and support [10]. Clinical proficiency of healthcare professionals is essential to the standard of patient care. Traditional didactic education has a limited ability to provide genuine or nearly real experiences and chances for student, clinician, and patient interaction because of the complexity of clinical situations [11-12]. Knowledge and skills acquired through clinical practice are fundamental and critical to the professional learning for clinicians and students in healthcare disciplines [13]. The effect of e-learning on the clinical field has always been the focus of educational authorities, but in terms of face-to-face contact between the doctor and the patient, it has been less favored; although electronic tools have come to the aid of medical students [14].

Sedation and analgesia in the emergency departments refers to the technique of prescribing sedative medications with or without painkillers; which alters the level of consciousness so that an individual can tolerate a painful or unpleasant procedure without disturbing his/her cardio-pulmonary function [15-16]. The patient response to sedation is sometimes unpredictable and it may not be possible to estimate how a patient react, therefore the therapist who wants to administer sedation must be able to consider lower or higher doses of sedation and its complications [16-17]. The complexities of sedation in the emergency room highlight the importance of proper training of this topic to medical students. As mentioned, with the online teaching methods in the last two years, there have been concerns about the level of clinical abilities of medical students, especially in emergency departments [18]. So, in this study we aimed to compare two methods of learning, e-learning and discussion based learning, on the rate of acquisition of sedation knowledge and medical students' satisfaction in the emergency department.

Methods

Study Design

The study was performed as an analytical descriptive prospective study comparing 2 groups and had a pre-test and post-test design.

Participants

Participants consisted medical interns from Tabriz University of Medical Sciences. They were recruited from the eighth semester (out of altogether 12 semesters forming the medical education in Iran) and had just started their training course in the emergency department. They were asked for their voluntary anonymous participation and recruited either via student mailing lists or by calling the students from their dormitory. They were informed they would be tested without any pass or fail criteria. Participants gave their written informed consent for participation.

In this study, 129 interns of the emergency medicine department were included. These students were randomly divided into two randomly permuted blocks, group I and II, using the online software available at www.randomization.com.

Group 1: students who received training about sedation based on the electronic methods (e-learning)

Group 2: students whose training was based on discussion methods.

All the steps and protocols of this project were approved by the ethics committee of the Tabriz University of Medical Sciences. Ethics Code: IR.TBZMED.REC.1400.225.

Learning Tools

The specialized software which prepared by Tabriz University Technical Faculty in which information about the indications, contraindications, recommended dosage,

and precautions were explained separately in Persian language for each sedative drug. This software was provided to Group 1 inters in order to install it on their own smart phones. Also, different methods of grading sedation and the criteria of inadequacy of sedation were explained in this software. In addition, the methods of prescribing and administering medication for advanced cardiac-pulmonary resuscitation were explained. Before starting the course, a 3-hour face-to-face workshop was held for the participants in the online training group to get familiar with the application environment and to comprehend how to use it. In this workshop they figured out the registration steps, different components of the program, how to get access to the program and how to use the chat room. Also, each participant was given a username and password through which he or she could get access to the program. Access to the chat room, program guides and further studies and slides were possible for each individual at any time (except within the exams).

For interns in Group 2, six hours of discussion-based training in relation to using sedatives, its different levels, criteria of inadequacy of sedation and the method of prescribing and using advanced cardiac-pulmonary resuscitation medications were held for 3 consecutive weeks (2 hours each week).

Tests and Evaluations

For both groups, before the intervention, a pre-test (including 32 question) was obtained from participants based on standard (parallel) multiple-choice questions following the principles of Haladyna et al [19]. The test had different topics, including the definition of sedatives, their different levels, the criteria of inadequacy of sedation, and the reasons for the interaction of these medications with the function of the ventilator and patient ventilator dyssynchrony and the properties of intravenous sedatives. At the end of the course (after 1 month), the post-test, which had the same questions as the pre-test, was obtained from the interns of both groups. The questions had a diverging fineness from a simple detection of knowledge up to a complex clinical vignette. The contents followed a list of clinically relevant issues covering background knowledge, diagnostics, examination and treatment of each disease. The items of the list were defined by clinical specialists from the faculty whom were blinded for the contents.

Statistical Analysis

Data of this study were analyzed using the statistical software IBM SPSS Statistics Version 22.0 (IBM Corp., New York, USA). The normality of the distribution was assessed by the Kolmogorov-Smirnov test before applying parametrical testing. For group comparison, the student's t-test as adjusted by the Bonferroni correction was applied. The personal data and tool evaluations were analyzed by using Spearman's ρ. P value <0.05 was considered as significant level.

Results

Altogether, 129 interns were entered in this study. The demographic characteristics of the study participants are summarized in (Table 1). The mean age of participants in the e-learning group was 22.30± 10.36 years and in the discussion-based group was 21.9± 9.76 years, therefore there was no significant difference between the two groups (P=0.315). In term of sex distribution, in the e-learning group and discussion-based group 52.3% and 46.7% participants were female, respectively, with a non-significant difference (P=0.219). Moreover, 80% students of the e-learning group and 76.5% of the participants in discussion group reported that they had no experience of online classes in the university before the COVID-19 pandemic.

Knowledge of using the narcotics for sedation

In (Table 2) the knowledge about the use of narcotics for sedation has been reported. The results of the pre-test showed that before the training, there was no significant difference between the two groups in terms of knowledge of using the narcotics (P=0.392). However, the results of the post-test compared to the pre-test showed that the effect of both types of training (e-learning and discussion-based training) on the knowledge related to the use of narcotics for sedation was statistically significant and the mean scores of students trained in both methods after teaching increased significantly compared to pre-teaching (P=0.01 for the e-learning group and P<0.001 for the discussion-based group). Nevertheless, the rate of this improvement in the discussion-based training group was significantly higher than the online training group (P<0.001).

Knowledge related to the use of intravenous anesthetics for sedation

Regarding the topic of knowledge related to the use of intravenous anesthetics for sedation, learning rate of the students between the two groups (e-learning and discussion-based) were comparable and there wasn't a statistically significant difference between two groups before the training course (P=0.308) (Table 3). However after providing the training course, a statistically significant difference was observed in the scores of the subjects of the electronic training group and the discussion-based training group, while the mean scores of the interns participating in the discussion-based group, in the comprehension of using intravenous anesthetics for sedation was significantly higher than the scores of electronically trained interns (P<0.001).

Knowledge related to definition and clinical judgments of sedation for emergency department interns

Before the onset of the training course in both groups and based on the results of the pre-test, no significant difference was observed between the two groups in terms of science related to definition and clinical judgments for

sedation (P=0.456). However, we found a significant improvement in both groups at the end of the study, but it has been reported discussion-based education resulted in stronger efficacy than e-learning education (P<0.001) (Figure 1).

Knowledge related to the use of Neuromuscular blocking agents (NMBAs) for sedation in the Emergency Department

Similar to the knowledge related to other aspects of interns' training, in connection with the use of NMBAs, no difference was observed between the two groups at the beginning of the study (P=0.993). But after providing the instructions, a statistically significant difference was observed in the scores of the subjects of the electronic learning group and the discussion-based training group. In the discussion based group the percentage of correct answers to the questions related to using NMBAs for sedation, were higher than the interns trained in the e-learning method (P<0.001) (Table 4).

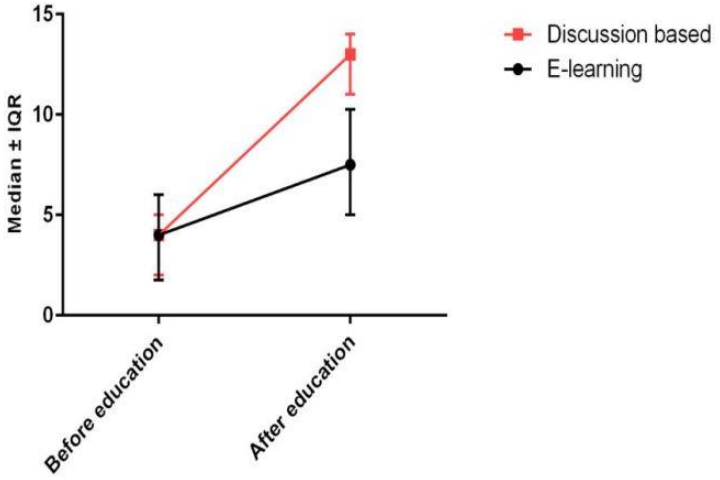

Figure 1- Comparison of science related to definition and clinical judgments for sedation between the two groups

Table 1- Participants' characteristics

Variables	e-Learning group (n=65)	Discussion group (n=64)	P value
Age (years)	22.30± 10.36	21.9± 9.76	0.315
Sex (Female%)	34 (52.3%)	30 (46.7%)	0.219
Online medical classes before this pandemic			
NO	52 (80%)	49(76.5)	0.465
YES	13 (20%)	15 (23.5%)	

Table 2- Comparison of e-learning and discussion-based groups based on knowledge about the use of narcotics in sedation

knowledge about the use of narcotics in sedation (Total Score from 5)	e-learning group (n=65) median (interquartile range)	Discussion Based group (n=64) median (interquartile range)	P value
Before training	1 (0-2)	1 (0-1)	0.392
After training	2 (2-4)	4 (3-5)	<0.001
P value	0.01	<0.001	<0.001

Table 3- Comparison of e-learning and discussion-based groups based on knowledge related to the use of intravenous anesthetic drugs in sedation

Knowledge related to the use of intravenous anesthetic drugs in sedation	e-learning group (n=65) median (interquartile range)	Discussion Based group (n=64) median (interquartile range)	P value
Before training	1 (0-3)	1 (0-3)	0.308

After training	5 (4-7)	9 (7-11)	<0.001
P value	0.025	<0.001	<0.001

Table 4- Comparison of e-learning and discussion-based groups based on knowledge of the use of skeletal muscle relaxants in sedation

knowledge of the use of skeletal muscle relaxants in sedation		e-learning group (n=65) median (interquartile range)	Discussion Based group (n=64) median (interquartile range)	P value
Before training	Number of subjects with True answer (%)	5 (7.5%)	6 (9%)	0.933
	Number of subjects with False answer (%)	60 (92.5%)	58 (91%)	
After training	Number of subjects with True answer (%)	21 (32.3%)	48 (75%)	<0.001
	Number of subjects with False answer (%)	44 (67.7%)	16 (25%)	
P value		<0.001	<0.001	<0.001

Discussion

The results of the present study showed that holding training course online or based on discussions can improve the ability of the emergency department students to recognize sedative drugs and related protocols, however, the learning rate was significantly higher in the discussion-based group than the e-learning group.

With the expansion of the web space and online communication tools, the use of alternative methods for teaching in educational and research centers is increasing all over the world [20-21]. Lectures and discussion-based learning are among the teaching methods that due to various reasons, such as low cost, the possibility of transferring high amount of educational contents in shortest time, needing less facilities, familiarity and mastery of university professors to this method, has made it one of the common educational methods, especially in low-income countries. Although the main component of education is the necessity of learning, but in the lecture method students are not given the proper opportunity to think and learn, and often a considerable amount of presented concepts is forgotten after a few weeks. For this reason, based on the studies, the correct education of learners depends on creative, critical, scientific and effective educational system, and some of the traditional teaching methods will not meet the educational needs of the current generation [22-23].

When discussing these results with regard to publications in this field, which also looked at various knowledge tests, different groups of studies can be distinguished.

Alexander et al showed that the calculated gain of knowledge clearly showed a significant benefit for the users of podcasts in comparison with those who used textbook chapters. As podcasts are considered one kind of e-learning method, therefore the findings of this study is against the results of our study [35]. Some studies have investigated the effectiveness of discussion-based education compared to lecture-based education on students' learning. Zhou et al in a prospective, randomized control trial was evaluated the effect of discussion-based learning compared to the lecture-based learning on immediate and long-term knowledge of undergraduate medical students and found that discussion-based learning lead to a significant higher improvement in the practical knowledge and potentially improved long-term knowledge retention when compared with lecture-based learning [24]. Also, Yilmaz et al. in a study among the student's understanding of genetics concepts, compared the effects of prediction/discussion-based learning cycle, conceptual change text, and traditional instructions and the results revealed that prediction /discussion based and conceptual change text learning lead to significant better score than traditional learning [25].These studies show that old discussion based teaching methods cannot fulfil today's students educational needs therefore discussion based teaching systems should be updated. Knowledge and skills acquired through clinical practice and discussion-based learning are fundamental and critical to professional learning for clinicians and students in healthcare disciplines. However, due to constricted clinical hours and sometimes the need to travel to other cities and countries to participate in training courses, unexpected occurrence of particular illnesses in patients, and the individuality of each patient and his or her support system, such clinical situations are restricted and distinct for each student [26].

An e-learning system can boost students' chances to research and learn from educational resources on their own schedule due to the benefit of flexibility linked to time, space, and speed. In the present study, we found that e-learning lead to a significant improvement in the medical students learning rate. However, when we

compared e-learning methods with discussion-based learning method, the effectiveness of discussion-based learning was more. In line with our findings, Feng et al. in a systematic review study found that situated e-learning method caused a significant improvement in the knowledge and performance of medical and nursing students. However, when they compared the effect of e-learning with traditional methods, the effect of e-learning on performance remained significant, but for the participants' knowledge, this significant effect disappeared. The subgroup analyses indicate the situated e-learning program significantly improved students' clinical performance but not for clinicians [27].

Khoshbaten et al. in another comparative study were compared the effects of e-learning versus lecture-based learning on knowledge related to advanced cardiac life support drugs pharmacology and they found that electronic learning method was not associated with considerable increase in the knowledge of interns in this group compared with the lecture-based group [28]. Also, Soleimanpour et al. compared the effect of e-learning versus lecture-based learning in improving emergency medicine residents' knowledge about mild induced hypothermia after cardiac arrest. It has been reported in their study that there was no statistically significant difference in terms of the learning method between the test scores of the 2 groups [29].

One of the reasons that causes different results among the students and clinicians could be the limited clinical experiences of students, and the addition of a virtual situation is very beneficial to a novice learner, but not for experienced learners with their skills acquired from clinical practice [30]. In another systematic review, Sinclair et al. evaluated the effects of e-learning on clinician behavior and patient outcomes. The findings indicate that e-learning was at least as successful as conventional learning methods and outperformed no instruction in changing the behavior of healthcare professionals [31].

Asynchronous online learning courses offered by third parties have increased in recent years for the continuous education of healthcare professionals. Australian Primary Health Care Nurses Association's online portal [32], the Renal Society of Australasia online nephrology education portal [33], and the Australian National Cancer Nursing Education Project [34] are among the institutions that provide medical and health-related training to medical system personnel in electronic form. One of the reasons that make e-learning more popular among clinicians and students of medicine, nursing and paramedicine is the cost-effectiveness of these trainings in terms of time management. In such a way that most of these training courses are presented both online and offline and the learner has the ability to watch the videos of the courses again based on their free time [21, 34]. However, there are some obstacles that make e-learning among clinicians and medical students and related fields somehow inefficient. Lakbala1 et al. in a cross-sectional study among the 286 medical university students in Iran, found that some barriers especially lack of proper training in e-learning courses, limited communication with the instructor and the difficulty of holding some practical classes in the online environment were among the main limitations in e-learning training [35].

Considering some limitations in e-learning, researchers have made suggestions to strengthen and increase the efficiency of this type of education. Recently, in a systematic review study, it has been revealed that some factors such as interaction and collaboration between learners and facilitators; considering learners' motivation and expectations; utilizing user-friendly technology; and putting learners at the center of pedagogy improves the effectiveness of e-learning [36].

To our knowledge the present study is the first study which compared the effects of discussion-based learning with e-learning among the emergency department students. However, there were some limitations that should be considered in interpreting the results of this study. One of the limitations of using e-learning methods is that some participants do not master the skills of using applications and computer programs. To solve this problem, we tried to include students who have a relative mastery of the mobile software. On the other hand, we tried to designed this software user-friendly and easy to use. Another limitation was the amount of active participation of the students in the discussion group. Even though the students participated in this study voluntarily, some of these students only attended the meetings and participated less in the discussions, and this may affect their learning process. Another hypothetical weakness may be the fact that this study was only performed in Persian. The results might differ if the learning tools were used in other languages.

Conclusion

The use of e-learning and discussion-based learning methods led to a significant improvement in the acquisition of sedation knowledge for emergency department interns. However, comparing these two methods, the discussion-based method had more favorable results on the learning process of the interns. Future studies are needed to investigate the effectiveness of mixed methods (e-learning plus updated discussion based learning) compared to traditional methods on acquisition of knowledge for students.

Abbreviation

ED: Emergency Department
RSI: Rapid Sequence Intubation

Ethics approval and consent to participate

This study was approved by the regional ethics committee with No. IR.TBZMED.REC.1400.225. Written informed consent was obtained from each participants in the study. We confirm that all methods were performed in accordance with the relevant guidelines and regulations

Consent for publication: The data presented in the manuscript and its supplemental files do not contain any details relevant to any individual patient and thus, no consent for publication was required

Availability of data and materials: The datasets generated during and analysed during the current study are not publicly available due to restriction of ethic committee of Tabriz University of Medical Sciences but are available from the corresponding author on reasonable request.

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