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Original Article

The effect of flipped classroom on medical students' resuscitation knowledge and practical skills

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Abstract

Introduction: In the flipped class, students study the educational content before attending the class. They enter the classroom for cooperative learning, therefore, in this project, the effect of holding a critical care workshop in the flipped teaching method on the improvement of knowledge, and practical skills in medical students has been investigated.

Methods: In this descriptive interventional study, the sample size was calculated to be 45 people in both groups. The educational content of critical care through the center's website and virtual channels was provided to the intervention group a month ago, and then the students practiced and asked questions in the practical class under the supervision of the professor. The knowledge, and practical skills in the fields of intubation, ATLS, BLS, and ACLS were checked before and after the training through a questionnaire and OSCE test.

Results: The acceptable amount of students' awareness in doing critical care between two training and control groups after training and two months after training is statistically significant ($P<0.001$). The difference in the average skill score of students in critical care was statistically significant ($P<0.001$).

Conclusion: Learning through interaction and discussion increases knowledge, improves skills and stability, and deepens learning in critical patient care education.

Introduction

Critical care is the direct delivery of medical care by a physician to an injured or critically ill patient,[1] where involves making complex decisions on evaluating, managing, and supporting the function of vital systems to treat the failure of one or more vital organs or to prevent life-threatening deterioration.[2]

The results of studies have shown that by performing faster and more correct resuscitation operations in patients with cardiac arrest, the chance of success would increase, while with each passing minute, the patient's survival chance decreases by 7% to 11%.[2] Lack of access to skilled and trained individuals, delays in starting a massage, and massage techniques are factors that influence the resuscitation process.[3] Studies have shown that the ability of newly graduated physicians in critical care skills is moderate to weak.[4-6] Also, in a study in Iran, the skill level of physicians was estimated to be average.[4]

Due to the priority of saving the patient's life in hospitals, it should be noted that endotracheal intubation and cardiac resuscitation in training hospitals are performed by the resuscitation team and anesthesia and emergency medical technicians, and the physicians have limited training opportunities.[3]

As technology advances and medical science becomes more complex, the needs of patients get more complex, as well. Accordingly, the responsibility of medical science masters has become more serious and complicated than in the past. It is no longer possible to lead medical students to advanced development through traditional methods.[3] Medical science education, including medicine, needs an essential change to enhance clinical decision-making capacities by using new teaching approaches and increasing student-centered learning so that it can give rise to the growth of self-confidence graduates and original thinkers who could be ready for practicing modern and sophisticated medicine.[7-9]

Teaching is a two-way process between the instructor and learner as well as a two-way process of teaching and learning. In the traditional teaching method, information was passed from instructor to learner.[7] Education at any level can create learning, but different methods have different depths and stability.[10,11] In recent decades, educational planners have been looking for ideas that use e-learning technologies as a powerful component for deeper and more active learning in educational systems. One of the educational models that have been considered for this purpose in recent years is the flipped classroom

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method, which was first introduced in 2006.[12,13]

The flipped model is considered a developing model of new and pedagogical educational movements that are dependent on technology.[14] In place of traditional speeches, in this model, students watch video lectures that they have access to them before the lecture room and act their studies or pre-class tasks so that they are prepared for collaborative teaching.[15] The flipped model approach guarantees the activity of a learner in the classroom. So the students will be active in the class.[16,17] This educational method raises student participation[18] and, and the teacher will not only be in the role of a transmitter of information but will also be in the role of a mentor. By giving feedback to students, the instructor plays a more cooperative role in this process of education.[19] In the flipped model, students review what they have learned in their minds and then discuss this data in class.[20]

Christopher et al. found that this model has gained wide acceptance in medical education. Therefore, holistic education is more effective in promoting student learning in all areas of knowledge and skills. several learners also reported that in the reverse model, if students do not study the content before class and come to class unprepared, they will not participate in discussions and therefore learning will not occur appropriately, while this model enhances students' self-study skills and enhances their satisfaction.[20]

According to the researcher's experience in instructing clinical skills on educational simulators and the medical students need to learn critical care skills on one hand and given that improving the quality of clinical skills with new methods is directly related to better saving the life of patients on the other hand, here, we sought to compare the impacts of the flipped classroom method on medical students' resuscitation knowledge and practical skills with the traditional methods using the available equipment and technology in the Skills laboratory located at Tabriz Medical School.

Methods

In this descriptive interventional study, the study population of this pre-post interventional descriptive study was all medical students of Tabriz Medical School, and the research environment was the Skills Laboratory in 2022.

Since there was a total number of 116 externship students, by taking a 5% probability of falling into account, the sample size was calculated to be 90 individuals through the Morgan table (an error rate of 0.05 and reliability of 95%). The sample size was calculated to be 45 people in both groups. Before the study, each subject in the project signed a detailed informed consent form.

The division was through simple random sampling. The inclusion criteria were willingness to participate in the study and being a medical student in Externship Course I, the one who has not passed any other training course.

Through this research, the educational content included a video on how to perform cardiac resuscitation, airway management, and educational scenarios that were provided to the intervention group through the website and channels of the Clinical Skills Center one month ago. Then, as a practical exercise on medical moulage, the flipped classroom was held by a relevant professor in a questioning and answering format through three 2-hour sessions in the model hospital of the Clinical Skills Center of the Medical School. Students' knowledge in 3 skills (intubation BLS, and ACLS) before and two months after education and their practical skills after the education were evaluated by an OSCE test through a standard checklist of the Ministry of Health. Furthermore, to measure the stability of the skill, the test was repeated after the end of the relevant part (2 to 3 months later).

The utilized instrument to evaluate the knowledge, skills, and stability of the clinical skills was the standard checklists of the Ministry of Health, which had been approved by professors and was used as a standard instrument to evaluate the clinical competence of medical students at the end of the general medicine course. The test evaluators were the same professors who instructed the students in both groups, thus there was no need to adapt the evaluators. The single-blind method was used in such a manner that the test evaluators were unaware of the grouping of students in all stages of the OSCE test. Since the Clinical Skills Center did not interfere in the students' course scoring process, there was no damage to the students.

Creating opportunities for pre-learning educational topics is the first step of the flipped classroom method. Hence, we attempted to consider the most recent and comprehensive source for each of the educational disciplines after reviewing the sources and topics proposed by the Ministry of Health. Also, all recorded files in terms of audio and video quality should have been reviewed and approved by the instructor before being provided to students. Regarding the use of uploaded files in internal sharing services, their scientific accuracy and quality were confirmed by the instructor. For data collection, students' knowledge, practical skills, and skills stability were investigated through statistical-analytical tests (analysis of variance and t-test) and analyzed by SPSS 20.0.

Results

In this study, 90 medical students (Externship I) participated. A total of 45 students received critical care education in the flipped classroom and 45 students received traditional critical care education as the control group. Of all participants, 46 (51.1%) were male.

The extent of students' knowledge in ACLS, intubation, and BLS

The results by t-test method: there wasn't variation between groups in the knowledge.

However, the mean score of knowledge about ACLS,

intubation, and BLS in the intervention group was significantly higher than the control group, and also after two months ($P<0.001$ (Table 1).

According to the paired t-test, there was no statistically significant difference in the mean score of knowledge about ACLS, intubation, and BLS after education ($P>0.05$).

The extent of students' skill in performing ACLS, intubation, and BLS

Over time, the average score of students' skills in performing of BLS in the test and control groups was decreased and increased, respectively. However, according to the analysis of variance, were not significant in doing BLS over time ($P=0.70$, Figure 1). There was a difference between students' skills in doing BLS ($P<0.001$, Table 2).

Based on the analysis, students' skills in performing ACLS were significant over time ($P<0.001$) so the skill score increased in both groups (Figure 2). Students' skills in intubation were not significant ($P=0.24$) over time (Figure 3). Moreover, the ACLS and intubation skill of the intervention group was higher than that of the control group (Table 2).

Discussion

The present study investigated the effect of the flipped classroom method on Tabriz medical students' resuscitation knowledge and practical skills. The results showed that the mean score of resuscitation knowledge in the test group was higher than the control group after the test and two months later. Also, the average score of

Table 1. The mean score of students' knowledge in ACLS, intubation, and BLS in two intervention and control groups through three studied times

Skills	Time	Mean ± standard deviation		*P* value
		Control	Intervention	
BLS	Before the test	7.47 ± 1.53	7.89 ± 1.34	0.167
	After the test	12.83 ± 1.55	17.03 ± 1.63	<0.001
	Two months after the test	12.83 ± 1.55	17.03 ± 1.63	<0.001
ACLS	Before the test	5.16 ± 1.57	5.69 ± 1.53	<0.121
	After the test	12.84 ± 1.57	17.01 ± 1.66	<0.001
	Two months after the test	12.84 ± 1.57	17.01 ± 1.66	<0.001
Intubation	Before the test	5.02 ± 1.86	4.98 ± 1.85	<0.921
	After the test	12.48 ± 2.26	17.04 ± 1.62	<0.001
	Two months after the test	12.48 ± 2.26	17.04 ± 1.62	<0.001

Table 2. The Average score of students' skills in ACLS, intubation, BLS after innervation

Skills	Time	Mean ± standard deviation		*P* value
		Control	Intervention	
BLS	After the test	12.42 ± 2.34	18.87 ± 1.16	<0.001
	Two months after the test	13.51 ± 2.76	18.08 ± 2.06	<0.001
ACLS	After the test	7.24 ± 7.07	13.29 ± 3.86	<0.001
	Two months after the test	11.5 ± 3.96	16.66 ± 2.21	<0.001
Intubation	After the test	12.09 ± 3.44	15.27 ± 2.64	<0.001
	Two months after the test	11.83 ± 3.27	16.4 ± 2.53	<0.001

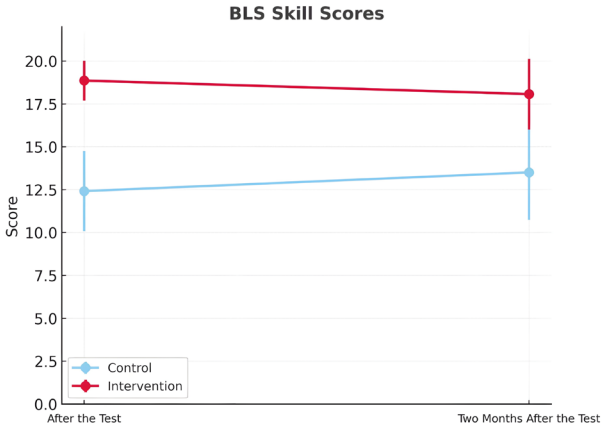

Figure 1. BLS skill scores between control and intervention groups

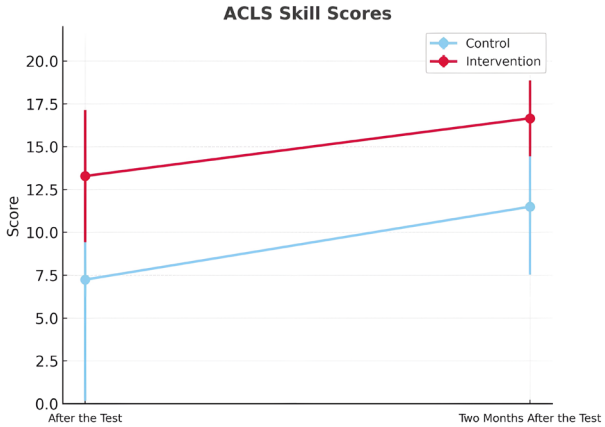

Figure 2. ACLS skill scores between control and intervention groups

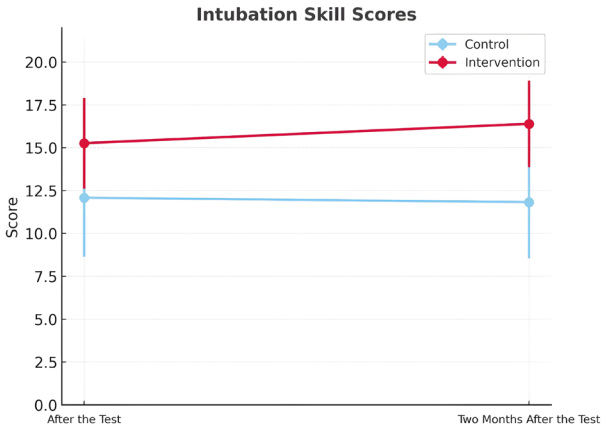

Figure 3. Intubation skill scores between control and intervention groups

resuscitation practical skills (intubation, ACLS, and BLS) in the test group was higher. Therefore, it might be stated that flipped education of clinical skills (intubation, ACLS, BLS) is effective.

Missildine and Bagi also showed that by using this model, students' performance increases.[9,21] According to Harrington's study, the average grades of nursing students in the flipped classroom were higher than in the lecture group.[22] Also, Critz & Knight[23] and Schwartz[24] used the flipped classroom method to teach students in some nursing courses, and the results showed high student satisfaction.

However, these findings contradict the findings of a study by Misseldine et al. Nursing students were more satisfied with flipped education than other educational methods.[10] Due to the available evidence, it is not possible to explain exactly the reason for the variety of experiences and the level of satisfaction of nursing students with the flipped class method. Yet it must be noted that the flipped classroom approach is only a framework and might be practiced in different ways, as has been done through different ways in various faculties.[19]

In line with the results of this research, the results of a study by Namdar Ahmadabad et al showed that learning motivation between students leads to deeper learning in the flipped class.[25,26]

Similarly, the results of Jafarghaei et al's study also showed that most students preferred flipped learning over methods in which most of the class time was spent lecturing by the teacher.[19] Therefore, students had a positive attitude towards this method. Due to the novelty of this educational approach, more studies are needed to investigate its impact on different learning outcomes.[27] The findings of this study showed that physics students in flipped classrooms achieved better learning outcomes, which is similar to the achievements of other research conducted in this field.[29,30]

Emily et al. indicated the flipped classroom method increased the skills of nursing students. The students were satisfied with the flipped classroom.[30]

Conclusion

We investigated the effect of holding a flipped education method on improving resuscitation knowledge, practical skills, and stability of medical students at Tabriz University of Medical Sciences. Based on the results, the reverse classroom method can increase knowledge, skills, stability, and deep learning of learners about resuscitation by establishing motivation in learning, learning through interaction and discussion, and learning based on the link between pre- and post-classroom activities while being accepted and satisfied by learners. Therefore, it can be concluded that the reverse method is a suitable model for teaching medical units and can be chosen as a suitable alternative because it makes students actively involved in the learning process and provides the basis for appropriate feedback. The results indicated better academic performance among FC students. Qualitative results indicated that the main reasons for this performance improvement were better data transfer between the instructor and the learner and better interaction between them.

One of the limitations of this study was the lack of a satisfaction survey; the students' and professors' views on teaching critical care in a flipped classroom were in the form of a questionnaire and their satisfaction was assessed through oral questions by workshop experts.

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Authors' Contribution

Conceptualization: Hamidreza Morteza Bagi.
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Funding acquisition: Hossein Ghanet.

Study Highlights

What is current knowledge?

- Lack of access to skilled and trained individuals, delays in starting a massage, and massage techniques are factors that influence the
- resuscitation process. Studies have shown that newly graduated physicians' critical care skills are moderate to weak.

What is new here?

- The reverse classroom method can increase knowledge, skills, stability, and deep learning of learners about resuscitation by establishing motivation in learning, and learning through
- interaction and discussion, and learning based on the link between pre- and post-classroom activities, while being accepted and satisfied by learners.

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Competing Interests
No conflict of interest has been declared by the authors.

Ethical Approval
This study has received approval from the Regional Ethics Committee of the Emergency Department of Tabriz University of Medical Sciences with registration number IR.TBZMED.REC.1398.994.

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