

Original Article



Investigating the effect of problem-based education on improving the performance of medical trainees in conducting interventions related to management of patients with trauma

Seyed Pouya Paknezhad¹ , Hamid Reza Morteza Bagi¹, Farnam Shokrzadeh¹, Sahel Vahdati², Sama Rahnemayan^{3,4*} 

¹Emergency Medicine Research Team, Faculty of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran.

²Department of Pharmaceutical and Cell Biological Chemistry, Rheinische Friedrich-Wilhelms University Bonn, Bonn, Germany.

³Aging Research Institute, Tabriz University of Medical Sciences, Tabriz, Iran.

⁴Student Research Committee, Tabriz University of Medical Sciences, Tabriz, Iran.

Article info

Article History:

Received: 3 Feb. 2020

Accepted: 2 Mar. 2020

e-Published: 20 Apr. 2020

Keywords:

- Trauma
- Education
- Problem-based Learning
- Emergency Medical Services

Abstract

Introduction: Trauma is the leading cause of mortality and disability in the countries. How to deal with a traumatic patient is one of the most important things and the individuals need to learn about it. The purpose of this study is to investigate the effect of problem-based education on improving the performance of medical trainees in the management of trauma patients, and identify students' skills status in order to advance educational goals; and thus increase community health.

Methods: In this randomized clinical trial, 76 Medical students were randomly divided into two intervention and control groups. Student performances were evaluated using standard checklists as a pre-test and post-test assigned. descriptive and statistical analysis of the acquired data was done using SPSS 20 software; and the parametric and non- parametric tests were used for the statistical analysis.

Results: There was no statistically significant difference in age at 23 years ($P=0.422$). In terms of sex distribution, there was also no statistical difference ($P=0.212$). The scores in the intervention group were higher than in the control group, but no statistically significant difference was observed between the two groups.

Conclusion: The results show that student-centered and cooperative methods have a greater impact on students' learning than lecturing. On the other hand, one should know that learning problem-solving itself has many limitations and problems with implementation.

Introduction

After 1967, trauma has been regarded as a disease, not as an accident.¹ Since then, there has been a great evolution in the field of surgery; and today trauma is considered as a major health problem in all societies regardless of their health, economic or social situation.² Trauma is the leading cause of mortality and disability in the developed and developing countries. It is estimated that 10% of the world's deaths are due to trauma, with 90% of these occurring in developing countries.³ It is expected that this rate will increase by 2030.⁴

How to deal with a traumatic patient is one of the most important things that individuals need to be aware of, to save their lives or prevent abnormal disabilities.⁵ Treatment of trauma patients is based on the Advanced Trauma Life Support (ATLS), which is based on initial patient evaluation and efforts based on the immediate

detection and treatment of life-threatening injuries such as airway obstruction and inadequate oxygenation, shock and severe injuries, and the intervention priority is based on algorithms (ABCs)⁶.

The current method for teaching how to manage trauma patients, in clinical departments by professors practicing in the clinical skills section of the medical school, is based on giving master lectures on standard models, worldwide. There are now efforts to develop new teaching methods for graduate learning.⁷

Learning is an active process in which each learner builds new knowledge based on his or her past experiences, present science, and general view of the world. Speech is one of the most common methods of teaching in a teacher-centered manner, where learners are passive and do not gain problem-solving skills; and have difficulty using the knowledge learned to solve the problem.

*Corresponding Author: Sama Rahnemayan, Student Research Committee, Faculty of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran. Tel: +989354348479, Email: rahnemayans@tbzmed.ac.ir

© 2020 The Author(s). This is an open access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

On the other hand, effective learning gives a higher self-esteem for trainees to effectively involve in the management process. Problem-based learning (PBL) is one of the most active and student-centered teaching methods. The PBL method was first developed in 1969 at McMaster University, Canada, as a student-to-student group learning solution for PBL-based learning.⁸

PBL is a way in which students determine the facts about a problem. They then produce ideas based on these facts; and later at the critical stage, they will have a better view of the problem with thoughts on the nature of the problem being posed. These ideas can be prioritized as much as possible, indicating that the group is thinking about the problem at hand. These ideas also help group members to understand their information deficiencies and needs.⁹

In the problem-solving learning curriculum, the primary role of the teacher is to facilitate the learning process by encouraging small group discussions based on case scenarios and providing constructive feedback rather than teaching specific facts.¹⁰ Thinking about problem-solving is also considered as the starting point in the learning process and students set their own learning goals in the group.¹¹

Whereas in the traditional method of teaching at universities, which is a teacher-centered approach, all course material is expressed by a lecturer and the student must receive and remember those materials readily.¹²

In problem-solving techniques, education is based on the expression or scheme of a problem or disease, its definition, discussion, and thinking about it. Students are then divided into groups, collaboratively researching a topic or issue, gathering the materials needed to solve and discuss it.

The quality of the trainings suggested for physicians, is very important due to the importance and sensitivity of their work; and it is not possible to improve educational quality without research. The purpose of this study is to investigate the effect of problem-based education on improving the performance of medical trainees in the management of trauma patients, and identify students' skills status in order to advance educational goals; and thus increase community health.

Methods

This randomized clinical study, was conducted in the Clinical Skills Center of Tabriz University of Medical Sciences (TUOMS). All medical students undergoing first year of externship at Tabriz University of Medical Sciences were included in this study; and taught how to manage trauma patients by lecturers and also working on medical stimulators.

Extracurricular students or students with no consent to continue the study at any time were excluded from the study. The sample size was 76, based on the number of externalities reported by the Honorable Deputy Education Officer, with a probability of a 20% drop in sample size;

and based on similar articles and studies, using Cochrane formula with the power of 80% and $\alpha < 0.05$. Informed consent was obtained from all the participants at the baseline. The participants were randomly divided into two intervention and control groups by simple linear randomization using excel software and random number table.¹³

The intervention group was trained in problem solving; and the control group was given traditional training (lecture) by emergency medicine professors. Students' Performance Study was tested as a pre-test and post-test assigned using the standard checklist approved by the US Department of Health's ATLS Standardized Checklist, and used worldwide by emergency medicine professors (2 or 3) with ATLS certificate in College of Surgeons, the United States.¹⁴ In order to blind the study, each professor evaluated the students alone and was not informed of the other teachers' evaluation score anymore. The checklist was prepared according to expert opinion and based on ATLS concept and its validity (0.86) and reliability (0.92) were defined using test-re-test method.

The training in both intervention and control groups was based on the ATLS book and was held in the morning and evening for 2 days. The professors in both groups were the same and qualified to teach ATLS. Based on the ATLS guidelines, the first part focuses on primitive surveillance and then enters into secondary surveys. One of the major focus areas in this guideline is how to control organ bleeding, fractures and dislocations, and how to manage wounds in different locations and conditions. Also how to perform life saving and limb saving are explained in detail, and at the end of each chapter a checklist on how to deal with a trauma patient is discussed.

This checklist is administered worldwide and validated by the American Surgeons Association. It is also updated every four years as guidelines change. Finally, descriptive and statistical analysis of the acquired data was done using SPSS 20 software; and according to the normal distribution of the data, the parametric and non-parametric tests were used for the statistical analysis.

Results

The mean age of all patients was 23.89 ± 2.13 years, with a median of 23 years; in the control group 23.86 ± 4.10 years with a median of 23 years, in the intervention group 23.32 ± 2.35 years with a median of 23 years. There was no statistically significant difference in age of two groups ($P = 0.422$).

In terms of sex distribution, there were 28 females and 22 males in the intervention group, and 23 females and 27 males in the control group; which were not statistically different ($P = 0.212$).

A comparison of the two groups in terms of students' performance in the three domains of airway management, wound management and blood circulation management, before the training, is presented in Table 1.

Table 1. Students' performance before training

	Mean ± SD		P value
	Intervention	Control	
Airway management	12.62±1.52	11.14±1.84	0.159
Wound management	13.86±1.41	13.06±1.28	0.461
Circulation management	10.12±1.54	10.16±1.69	0.902

The comparison of the two groups in terms of students' performance in the three domains of airway management, wound management and circulatory management, after the training, is presented in Table 2.

Discussion

In this study, we compared the effect of PBL on the improvement of medical trainees' performance in traumatic patient interventions. The results of a study by Koleini et al showed a statistically significant difference between traditional and PBL. So that PBL makes learning better than lecture-based learning.¹²

Haghani et al in a systematic review showed that problem-solving learning is effective in improving medical students' academic achievement; and in no study academic achievement in PBL was less than traditional or lecture-based learning.¹³ Despite this claim, Javid et al's study showed that lecturing led to better learning in the units under study comparing to PBL.¹⁵ The reason for the difference in results may be due to differences in the research community, working method, number of samples, and the teaching methods. It is likely that the lecture method will be effective for training the lower classes of the cognitive domain; and will have little effect on training the upper classes of learning; while the PBL method will be effective for both lower classes and upper classes of effective cognitive learning.

However, problem-solving learning seems to lead to better learning in the upper classes of the cognitive domain, which facilitates learning, enhances self-centered learning and lifelong learning, and enhances social skills. Whereas traditional teaching methods transfer information from teacher to student while the student is not given any opportunity to interact with the presented content and concepts.¹⁶ The dominance of teacher-centered and theorizing of professors reinforces and highlights students' learning style through taking notes and listening.¹⁷

Modanloo et al reported no statistically significant differences between the two lecture and problem-solving groups, which is consistent with our study.¹⁸ Additionally, Zarshenas et al noted that problem-solving style reinforces knowledge in a structured clinical position and motivates learning and develops clinical inference skills.¹⁹ The differences between two groups in this study and other studies showed the usefulness of problem-based approaches in groups that are larger than normal. This study was conducted exclusively in a group of medical

Table 2. Students' performance after training

	Mean ± SD		P value
	Intervention	Control	
Airway management	17.80±1.26	16.10±1.35	0.255
Wound management	17.50±1.66	16.90±1.64	0.230
Circulation management	16.92±1.33	14.82±1.33	0.709

students that had not been done before. There have also been reports of fear and frustration, time-consuming stress, and the difficulty of evaluating this practice.¹⁹

Panjehpour et al also state that it takes more time for the students to implement this method, and limits the transfer of lesson concepts from the teacher. Another point is the welcoming of students who have become accustomed to traditional and teacher-centered education systems in the country.²⁰

In the present study, at the beginning of the course, students showed a lot of resistance to intervention method; but at the end of the period, the mean number of absent students in the intervention group was significantly lower than the control group. Students gradually found this style of teaching enjoyable.²¹

Pastirik reported that moving from traditional systems to PBL may be stressful for students and may provide resistance.²² Students' satisfaction with participatory teaching methods reflects students' acceptance of new and active learning styles.²³ Mousaai Fard et al and Achike and Nain²⁴ argue that problem solving should be incorporated into the curriculum of the university curriculum and increase its efficiency by allocating more resources.

However, some experts are not very optimistic about the problem-solving approach. Momeni Danaei et al reported that some of the topics may be more applicable to students.²³ Namnabati et al reported that lecturing in nursing students lessons had a greater impact on students' learning and academic achievement.²⁵ Falaki et al indicated that pre-hospital trauma life support training improves EMS personnel's knowledge and skill in managing trauma patients; and PBL was more effective than traditional lecture-based learning.²⁶

Therefore, the choice of a variety of teaching methods, including PBL, depends directly on the type of lesson, its philosophy, and its content.

Despite the evidence of the usefulness of problem-solving teaching and the evidence that it generally generates a sense of satisfaction and delight in the students and teachers, educators who wish to use this approach should know that learning by problem-solving method itself, has many limitations and problems with implementation. On one hand, inclusive approaches require specific skills, and on the other hand, they are usually time-consuming, and teachers may find it difficult to cover all the educational content if they are committed to the content of the instruction.

Conclusion

In the present study, the scores in the intervention group are higher than in the control group, but no statistically significant difference is observed between the two groups. The results show that student-centered and cooperative methods have a greater impact on students' learning than lecturing. In all of these studies, the effect of student-centered learning was more than traditional method.

There are no significant differences between the two methods in our studies, but the scores in the instrument-based training group is 1 to 2 points higher than the control group.

Conflict of Interest

Authors have no conflict of interest.

Ethical approval

The study protocol was approved by the ethical committee of Tabriz University of Medical Sciences (IRTBZMED.REC.1398.542), and also it registered in the Iranian Registry of Clinical Trials website (identifier: IRCT20180928041159N1).

Authors' Contribution

Study design, SP; study conduct, HRMB; data gathering, FS; writing and analysis, SV; critic and scientific writing, SR.

Acknowledgements

The authors gratefully acknowledge TUOMS for financial support and for their kind cooperation. Besides, the authors appreciate the participants of this study.

Funding

The authors received no financial support for the research, authorship, or publication of this article.

References

- National Academy of Sciences (US) and National Research Council (US) Committee on Trauma; National Academy of Sciences (US) and National Research Council (US) Committee on Shock. *Accidental Death and Disability: The Neglected Disease of Modern Society*. Washington (DC): National Academies Press (US); 1970.
- National Research Council (US). *Injury in America: A Continuing Public Health Problem*. Washington, DC: National Academies Press; 1985.
- Peterson GN, Domino KB, Caplan RA, Posner KL, Lee LA, Cheney FW. Management of the difficult airway: a closed claims analysis. *Anesthesiology*. 2005;103(1):33-9. doi: 10.1097/00000542-200507000-00009.
- Ahmadi K, Sedaghat M, Safdarian M, Hashemian AM, Nezamdoust Z, Vaseie M, et al. Effect of Advanced Trauma Life Support program on medical interns' performance in simulated trauma patient management. *Chin J Traumatol*. 2013;16(3):145-8. doi: 10.3760/cma.j.isn.1008-1275.2013.03.004.
- Sahraian MA, Khorramnia S, Ebrahim MM, Moinfar Z, Lotfi J, Pakdaman H. Multiple sclerosis in Iran: a demographic study of 8,000 patients and changes over time. *Eur Neurol*. 2010;64(6):331-6. doi: 10.1159/000321649.
- Mahoori A, Hassani E, Noroozina H, Amiri Kar M. Evaluating the knowledge of Urmia university medical students about adult cardiopulmonary resuscitation. *Urmia Medical Journal*. 2010;21(3):260-5. [Persian].
- Prince KJ, van Mameren H, Hylkema N, Drukker J, Scherpbier AJ, van der Vleuten CP. Does problem-based learning lead to deficiencies in basic science knowledge? An empirical case on anatomy. *Med Educ*. 2003;37(1):15-21. doi: 10.1046/j.1365-2923.2003.01402.x.
- Arah OA, Heineman MJ, Lombarts KM. Factors influencing residents' evaluations of clinical faculty member teaching qualities and role model status. *Med Educ*. 2012;46(4):381-9. doi: 10.1111/j.1365-2923.2011.04176.x.
- Borimnejad L, Nikbakht Nasrabadi A, Mohammadi Mohammadi H. The effect of cardiopulmonary resuscitation workshop on nurses' sustained learning. *Iran J Med Educ*. 2008;7(2):209-15. [Persian].
- Saunders TR, Dejbakhsh S. Problem-based learning in undergraduate dental education: faculty development at the University of Southern California School of Dentistry. *J Prosthodont*. 2007;16(5):394-9. doi: 10.1111/j.1532-849X.2007.00216.x.
- Oda Y, Onishi H, Sakemi T. Effectiveness of student tutors in problem-based learning of undergraduate medical education. *Tohoku J Exp Med*. 2014;232(3):223-7. doi: 10.1620/tjem.232.223.
- Koleini N, Farshidfar F, Shams B, Salehi M. Problem based learning or lecture, a new method of teaching biology to first year medical students: an experience. *Iran J Med Educ*. 2003;3(2):57-63. [Persian].
- Haghani F, Shokri T, Omid A, Boroumand MA, Farajzadegan Z. Comparing academic achievement in lecture-based learning versus problem-based learning among medical students: a systematic review. *Iran J Med Educ*. 2014;14(8):729-41. [Persian].
- Advanced trauma life support (ATLS(R)): the ninth edition. *J Trauma Acute Care Surg*. 2013;74(5):1363-6. doi: 10.1097/TA.0b013e31828b82f5.
- Javid MA. Comparison between the effects of lecturing and problembased learning (PBL) on nursing students. *Iran Mag Educ Med Sci*. 1998;50:35-42. [Persian].
- Martyn J, Terwijn R, Kek MY, Huijser H. Exploring the relationships between teaching, approaches to learning and critical thinking in a problem-based learning foundation nursing course. *Nurse Educ Today*. 2014;34(5):829-35. doi: 10.1016/j.nedt.2013.04.023.
- Karimi Mooneghi H, Dabbaghi F, Oskouie F, Vehviläinen-Julkunen K. Learning style in theoretical courses: nursing students' perceptions and experiences. *Iran J Med Educ*. 2009;9(1):41-54. [Persian].
- Modanloo M, Khoddam H, Kolagaree S, Bastani F, Parvizi S, Abdollahi H. The effect of problem-based learning on nursing students' learning level. *Stride Dev Med Educ*. 2010;7(1):17-25. [Persian].
- Zarshenas L, Momeni Danaei S, Oshagh M, Salehi P. Problem based learning: an experience of a new educational method in dentistry. *Iran J Med Educ*. 2010;10(2):171-9. [Persian].
- AeiPanjehpour M, Ataee N. Comparison the effectiveness of problem solving method with lecture-based method in the teaching of metabolic biochemistry. *Iran J Med Educ*.

- 2012;11(9):1318-25. [Persian].
21. Khoshdel AR. The 41st ICMM world congress on military medicine, so far, so close! *J Arch Mil Med*. 2015;3(4):e60093. doi: 10.5812/jamm.34456.
 22. Pastirik PJ. Using problem-based learning in a large classroom. *Nurse Educ Pract*. 2006;6(5):261-7. doi: 10.1016/j.nepr.2006.02.003.
 23. Momeni Danaei S, Zarshenas L, Oshagh M, Omid Khoda SM. Which method of teaching would be better cooperative or lecture? *Iran J Med Educ*. 2011;11(1):24-31. [Persian].
 24. Achike FI, Nain N. Promoting problem-based learning (PBL) in nursing education: a Malaysian experience. *Nurse Educ Pract*. 2005;5(5):302-11. doi: 10.1016/j.nepr.2005.04.002.
 25. Namnabati M, Fathi Azar E, Valizadeh S, Tazakori Z. Lecturing or problem-based learning: comparing effects of the two teaching methods in academic achievement and knowledge retention in pediatrics course for nursing students. *Iran J Med Educ*. 2011;10(4):474-82. [Persian].
 26. Falaki M, Rajaei Ghafouri R, Shams Vahdati S. Problem-Based versus Lecture-Based Method in Pre-hospital Trauma Life Support Training; a Pre-test Post-test Study. *Arch Acad Emerg Med*. 2019;7(1):e70.