The effect of learning management system on ICU nurses' sustained learning about safe blood transfusion: A quasi-experimental study

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Abstract

Background and Aims: Transfusion of blood products is an important part of the health care system. Since one of the significant challenges in nursing education is using an effective method that provides depth and stability of learning, this study aimed to assess using a learning management system (LMS) for intensive care unit (ICU) nurses' sustained learning about safe blood transfusion in southeast Iran.

Methods: This was a quasi-experimental study in southeast of Iran in 2021 in two groups, control and intervention. Two ICUs received lecture training and two ICUs received LMS. The samples 80 nurses were selected by random convenience sampling. In the LMS group, the educational content was presented using Edmodo software. The control group received no intervention except for traditional education (lecture). The questionnaires were completed immediately, 1 month, and 3 months after the intervention.

Results: The mean score of knowledge immediately, 1 month and 3 months after the intervention were 9.53 ± 1.82, 9.46 ± 1.85, and 8 ± 2.94, in the lecture group and 8.91 ± 1.59, 9.47 ± 2.46, and 8.09 ± 1.94 in the LMS group, respectively. The mean score of practice immediately, 1 and 3 months after the intervention were 59.69 ± 39.6, 70.63 ± 7.4, and 83.70 ± 43.6 in the lecture group and 45.68 ± 55.5, 67.69 ± 4.56, and 35.70 ± 46.4 in the LMS group, respectively. The mean score of knowledge and practice in the two groups significantly increased immediately and 1 month and 3 months after intervention (p < 0.001). No significant difference was observed between the two groups (p > 0.05).

Conclusions: LMS method has a significant effect on improving the sustained learning of ICU nurses, and no significant difference was observed between the two educational methods. Hence, considering the busy work schedule of nurses, lack of staff, and the impossibility of physical attendance in lecture classes, it seems that LMS-based methods are appropriate alternatives to traditional learning methods.
INTRODUCTION

Blood transfusion (BT) is one of the most common procedures practiced in a hospital. The large number of transfusions performed in the hospital is related to intensive care units (ICUs), with more than a quarter of ICU patients undergoing transfusions of various blood products during their hospitalization. In spite of the clinical benefits of BT, there is the possibility of error at any stage of the transfusion process, which can cause serious and dangerous complications in the patient. Nurses play a major role in this process, and more than half of the chain of BT depends on nursing practice. For this reason, BT requires sufficient knowledge and skill on the nurses’ part. Providing continuous learning for nurses can improve their knowledge and skills and make desirable changes in the health system. Lecture-based teaching is a method that has a long history in educational systems. For several reasons, such as low cost, the possibility of transferring a great volume of information to a large group in the shortest time, and also the proficiency of educators in using this method compared to other methods, lectures are the most common means of teaching in Iran. However, in the current century, many educational activities are performed via the Internet and computer communications. E-learning provides the conditions to simultaneously use three traditional learning methods: visual, auditory, and textual.

With the significant increase in the use of e-learning, a variety of educational software has been developed in the form of learning management systems (LMSs) to facilitate online learning. LMSs help organize educational content and facilitate interaction between the learner and the instructor by creating private virtual classrooms. LMSs mainly allow doing tasks, handing in assignments, taking quizzes, asking questions, and receiving feedback from the instructor. Despite the widespread use of LMSs by learners, there is still no consensus on the effect of using these systems on learning in nursing. A literature review indicated that several studies had investigated the effect of using LMSs in teaching nursing students. The results of a study conducted by Saiz-Manzanares et al. in Spain confirmed the positive effects of LMSs on teaching nursing students. Laili and Nashir reported a positive effect of using the combination of face-to-face and Edmodo-based methods in nursing students in Indonesia. However, Alhosban and Ismaile reported that the experience of nursing students in Saudi Arabia in using an LMS has often been negative, especially in communicating, interacting, and receiving feedback. Feng et al. conducted a meta-analysis on 14 articles in which subgroup analyses showed that e-learning programs effectively increased learners’ knowledge and practice. But, Emami Sigaroudi et al. in Iran, concluded that the traditional education method is more desirable than the e-learning method in terms of implementing the first principles of education. Researchers believe that any education leads to learning, but the depth and stability of learning using different methods are different.

Studies in the field of blood transfusion show a lack of knowledge and poor performance of nursing staff in this field. So far, little attention has been paid to the effects of virtual education on nurses’ knowledge and practice in this regard. On the other hand, due to the busy professional of nursing, it is not economical to organize lecture classes and it is necessary to examine the effectiveness of virtual education. The most important issue in recent years is to evaluate the effectiveness of educational methods in sustained learning. Also, according to the researchers, educational software for nurses has not been used so far. And nurses have little knowledge of these soft wares. Due to the limited use of the Internet, the success of this educational method may be challenged. Hence, the present study was carried out to assess the effect of using learning management systems (LMSs) for ICU nurses’ sustained learning about safe blood transfusion in southeast Iran.

METHODS

The present quasi-experimental study was conducted in four trauma ICUs of Shahid Bahonar Hospitals in Kerman, southeast of Iran in 2021. This governmental hospital has the highest rate of patient admission to intensive care units with various diagnoses. All 100 intensive care unit nurses were screened in terms of inclusion criteria. Inclusion criteria included having a bachelor’s degree or higher in nursing and not having participated in BT educational programs within the 6 months leading to the study. By tossing coins two ICUs will receive random training, lecture training, and two ICUs will receive LMS. If both types of intervention are performed in one section, it is possible to transfer information. Therefore, it was decided that the nurses in each ward would receive only one type of intervention. Eighty ICU nurses were included in the study by convenience sampling method. Nurses were randomly divided into the two groups of control and LMS. Based on the study of Rafii et al. and also Type I error ($\alpha = 0.05$) and Type II error ($\beta = 0.02$), the sample size in each group was estimated at 24 nurses. Considering the dropouts, the final sample size was determined 30 nurses per group (Figure S1).

Measures

The background information questionnaire included demographic information (such as age, gender, etc.) and information about BT...
(source of receiving information, experience of acute reactions, and type of reactions).

A self-administered questionnaire, designed based on a literature review, was used to assess nurses' knowledge about the transfusion of blood products. The knowledge questionnaire consisted of 15 multiple-choice questions (1 = correct answer and 0 = incorrect answer). The knowledge score was 0–15. A self-administered questionnaire designed based on a literature review was used to assess nurses' practice in transfusion of blood products. The practice questionnaire consisted of 15 questions on a 5-point Likert scale (1 = never to 5 = always). The range of scores was 15–75. The questionnaires were assigned to 10 faculty members of Razi School of Nursing and Midwifery, and they were modified based on the experts' opinions to evaluate the content validity of the questionnaires. The content validity index (CVI) of the knowledge questionnaire and the practice questionnaire were 0.92 and 0.96, respectively. The questionnaires were submitted to 20 people who had the same characteristics as the research sample to assess their reliability. Cronbach’s alpha coefficients for the knowledge questionnaire and the practice questionnaire were 0.71 and 0.87, respectively.

2.3 | Ethics approval and consent to participate

This study was approved by the Ethics Committee of the Kerman University of Medical Science with No. 98000432 and code of ethics No IR.KMU.REC.1398.305. All methods were carried out following relevant guidelines and regulations. Participation in this study was voluntary. All participants were informed about the study's objectives and process, and their informed consent was obtained. NA affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

2.4 | Intervention

Educational content was prepared using a literature review.20,21 This content was provided to an ICU fellowship, 12 masters of ICU nursing with experience of working in the ICU, and five faculty members of the Nursing School, and their comments were considered and finally approved. This intervention was performed from December 2019 to April 2020. Both interventions started simultaneously to match the conditions of the two groups. In the lecture group, instruction was delivered using PowerPoint and simultaneously to match the conditions of the two groups. In the conference hall of a university hospital lecture group, instruction was delivered using PowerPoint and

2.5 | Statistical analysis

Data analysis was carried out using SPSS version 25. Descriptive statistics were used to analyze the participants' background data and the scores of each questionnaire. The Kolmogorov-Smirnov test indicated that the data had a normal distribution. The independent t test was used to compare the mean scores of knowledge and practice between the two groups, and \( \chi^2 \) and Fisher’s exact test was used to compare qualitative variables between the two groups. Analysis of variance (ANOVA) was used for intergroup and intragroup comparisons of mean scores at different times. \( p \) values less than 0.05 were considered statistically significant.

3 | RESULTS

In the present study, 80 ICU nurses were assigned to two lecture and LMS learning methods. The mean age was 33.13 \( \pm \) 5.39 years in the lecture group and 32.96 \( \pm \) 6.99 years in the LMS group. There was no significant difference between the two groups concerning the demographic variables, and the two groups were homogenous in these variables (Table 1).

The mean score of knowledge immediately, 1 month and 3 months after the intervention were 9.53 \( \pm \) 1.82, 9.46 \( \pm \) 1.85, and 8 \( \pm \) 2.94, in the lecture group and 8.91 \( \pm \) 1.59, 9.47 \( \pm \) 2.46, and 8.09 \( \pm \) 1.94 in the LMS group, respectively. And the mean score of practice immediately, 1 month and 3 months after the intervention
TABLE 1 Comparison of demographic variables in the study groups

| Variable                  | Lecture N (%) | LMS N (%) | Statistical analysis | p-value |
|---------------------------|---------------|-----------|----------------------|---------|
| Gender                    |               |           |                      |         |
| Female                    | 29 (93.5)     | 45 (91.8) | Fisher exact test = 0.82 | 0.7     |
| Male                      | 2 (6.5)       | 4 (8.2)   |                      |         |
| Education level           |               |           |                      |         |
| Bachelor degree           | 29 (93.5)     | 44 (89.8) | χ² = 0.33             | 0.7     |
| Master degree             | 2 (6.5)       | 5 (10.2)  |                      |         |
| Position                  |               |           |                      |         |
| Nurse                     | 31 (100)      | 46 (93.9) | Fisher exact test = 3 | 0.08    |
| Supervisor                | 0 (0)         | 3 (6.1)   |                      |         |
| Experience in BT          |               |           |                      |         |
| Yes                       | 29 (96.7)     | 49 (100)  | Fisher exact test = 95/1 | 0.16   |
| No                        | 1 (3.3)       | 0 (0)     |                      |         |
| How to get information    |               |           |                      |         |
| about BT                  |               |           | χ² = 3.28             | 0.1     |
| Personal                  | 4 (12.9)      | 15 (30.6) |                      |         |
| Workplace                 | 27 (87.1)     | 34 (69.4) |                      |         |
| Dealing with the          |               |           |                      |         |
| acute reaction of BT      |               |           | χ² = 0.52             | 0.49    |
| Yes                       | 12 (7.38)     | 23 (46.9) |                      |         |
| No                        | 19 (3.61)     | 26 (53.1) |                      |         |
| Type of reactions         |               |           |                      |         |
| Rash                      | 0 (0)         |           |                      |         |
| Hematuria                 | 22 (71)       | 2 (4.1)   |                      |         |
| Fever                     | 8 (2.85)      | 32 (65.3) |                      |         |
| Tachycardia               | 1 (2.3)       | 12 (24.5) |                      |         |

Abbreviations: BT, blood transfusion; LMS, learning management system.

4 | DISCUSSION

The present study aimed to compare the effects of lecture and LMS on the BT knowledge and practice of nurses in ICUs in southeastern Iran. The results showed that ICU nurses' mean scores of knowledge and practice in the two groups increased significantly compared to before the intervention. Also, no significant difference was observed between the two groups in this regard. Hence, based on the results, the two interventions effectively improved the knowledge and practice of ICU nurses. In the study conducted by Rafiei et al. to evaluate the effect of educational workshops and multimedia training on nurses’ knowledge and practice in the field of BT on nurses working in hospitals, the results revealed that both educational methods enhanced the knowledge of the nurses and no significant difference was observed between the two methods in this regard.11

A quasi-experimental study in Egypt on pediatric nurses’ knowledge and practice in BT showed that nurses’ knowledge and practice were significantly increased 3 months after the lecture.22 The results of the mentioned studies are consistent with those of the present study in terms of the effectiveness of lecture and multimedia training in nurses’ knowledge about BT and 3 months after the intervention.

Elewa and Elkattan23 also showed that various training strategies, including lectures, positively affect nurses’ practice in BT. The results suggested that educational programs positively impacted the nurses’ practice in BT in thalassemia patients and improved the quality of nursing care, increasing patient satisfaction.23 The results of the study conducted by Hugenholtz et al.23 confirmed the results of the present study and showed that both e-learning and lecture-based training methods were effective in increasing learners' knowledge, and there was no statistically significant difference between the two methods.24 Feng et al.27 conducted a meta-analysis on 14 articles in which subgroup analyses showed that e-learning programs effectively increased learners' knowledge and practice.18

Farshi et al. showed that in the area of nursing care training on air rescue by two methods, lecture and electronic, the mean score of knowledge after intervention in the two groups showed a significant difference, and this increase in the lecture group was significantly higher.25 Saiz-Manzanares et al.14 confirmed the positive effects of LMSs on teaching nursing students.14 Laili and Nashir reported a positive effect of using the combination of face-to-face and Edmodo-based methods in nursing students.15

In contrast to the present study results, the study conducted by Moazami et al.26 on 35 dental students to compare virtual and traditional training of dental students showed that virtual training was more effective than traditional training.26 One of the reasons for the difference in results of these two studies is the different nature of educational content and the tools used. Also, Hashemiparast et al. showed that the traditional education method is more desirable than the e-learning method in terms of implementing the first principles of education in nursing students. The difference between the tools used and the research community can be the reasons for the difference.27

Hashemiparast et al.’s finding showed that in the area of awareness of administrative staff of clinical departments by two methods,
lecture and electronic, the mean score of awareness of administrative staff was significantly higher in the lecture group.\textsuperscript{27} Perhaps the differences in instrument and aim of the study could be the causes of this contradiction.

**LIMITATION**

This study had its limitations. Lack of familiarity and knowledge of nursing care providers about the virtual method used. To solve this problem, a training session was held to get acquainted with the installation and use of the relevant software. Also, because the present study was conducted in a hospital and the learners of each intervention group may interact with each other, the learners of each intervention group were asked not to provide information to the other group during the study. To reduce the effect of information exchange, each type of intervention was performed in one section. Another limitation of this study was the reluctance of some nurses to participate in the study. With explaining the objectives of the study, we tried to attract their cooperation. It is recommended that similar studies be performed in multiple hospitals with larger sample sizes.

**CONCLUSION**

The present study results showed that both lecture and LMS methods have a significant effect on improving the level of knowledge and practice of ICU nurses, and no significant difference was observed between the two interventions. Considering the busy work schedule of nurses, lack of staff, and the impossibility of physical attendance in lecture classes, it seems that LMS-based methods are appropriate alternatives to traditional learning methods.
WHAT IS ALREADY KNOWN ABOUT THE TOPIC?

- Evidence-based knowledge and skills are essential for critical care nurses to enhance the quality of blood transfusion procedures.
- Standardized education is required for sufficient knowledge and skills of nurses in blood transfusion.
- Providing continuous learning for critical care nurses can improve their knowledge and skills about the principles of blood transfusion.

WHAT THIS PAPER ADDS?

- Using a learning management system (LMS) is an effective method for improving the level of knowledge and practice of ICU nurses about principles of blood transfusion, and it is as effective as the traditional method.
- Considering the busy work schedule of nurses, the lack of staff, and the impossibility of physical attendance in lecture classes, it seems that LMS-based methods are appropriate alternatives to traditional learning methods.

AUTHOR CONTRIBUTIONS

Mojgan Falaki: Conceptualization; data curation; investigation; software; writing—original draft. Mehdi Ahmadinejad: Conceptualization; supervision; writing—review & editing. Farideh Razban: Conceptualization; methodology; writing—original draft. Mohammad Ali Najafi-pour: Conceptualization; software. Neda Asadi: Conceptualization; funding acquisition; methodology; project administration; writing—original draft; writing—review & editing.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data are available upon request to the corresponding author after signing appropriate documents in line with ethical application and the decision of the Ethics Committee. Also, the authors confirm that the data supporting the findings of this study are available within the article.

TRANSPARENCY STATEMENT

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported, that no important aspects of the study have been omitted, and that any discrepancies from the study as planned have been explained.

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REFERENCES

1. Rudrappan RB. Evaluating the knowledge and practices of nurses and paramedics in blood transfusion services—a survey in the states of Tamil Nadu and Pondicherry, India. J Educ Health Promot. 2019;8.
2. Juffermans NP, Walsh TS. Transfusion in the intensive care unit. Springer, 2015.
3. Vincent J-L, Jaschinski U, Wittebole X, et al. Worldwide audit of blood transfusion practice in critically ill patients. Crit Care. 2018;22(1):102.
4. Bodagkhan F, Ramzi M, Vazirian S, et al. The prevalence of acute blood transfusion reactions in Nemazee Hospital. Sc J Iran Blood Transfus Organ. 2014;13(3):247-251.
5. Freixo A, Matos I, Leite A, et al. Nurses knowledge in transfusion medicine in a Portuguese university hospital: the impact of an education. Blood Transfus. 2017;15(1):49.
6. Holcomb JB, Tilley BC, Baraniuk S, et al. Transfusion of plasma, platelets, and red blood cells in a 1: 1: 1 vs a 1: 1: 2 ratio and mortality in patients with severe trauma: the PROPR randomized clinical trial. JAMA. 2015;313(5):471-482.
7. Kenett RS. Quality caring in nursing and health systems: implications for clinicians, educators, and leaders. Quality Progress. 2014;47(1):60.
8. Xu J-h. Toolbox of teaching strategies in nurse education. Chinese Nurs Res. 2016;3(2):54-57.
9. Safari M, Ghalhari L. Comparing the effects of lecture and work in small groups on learning of head and neck osteology in medical students. Iran J Med Educ. 2011;11(1).
10. Abbasszadeh, A., Borhani, F., & Asadi, N. (2011). Effects of health belief model-based video training about risk factors on knowledge and attitude of myocardial infarction patients after discharge. Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences, 16(2), 195.
11. Rafii F, Jan Amiri M, Dehnavi H, Haghani H. The effect of workshop and multimedia training methods on nurses’ knowledge and performance on blood transfusion. J Client-Centered Nurs Care. 2016;2(4):223-230.
12. Tagoe MA, Cole Y. Using the Sakai learning management system to change the way distance education nursing students learn: are we getting it right? Open Learn: J Open, Distance e-Learn. 2020: 1-21.
13. Sezer B, Yilmaz R. Learning management system acceptance scale (LMSAS): a validity and reliability study. Australas J Educ Technol. 2019;35(3).
14. Saiz-Manzanares MC, Escolar-Llamazares MC, Arnaiz Gonzalez A. Effectiveness of blended learning in nursing education. Int J Environ Res Public Health. 2020;17(5). doi:10.3390/ijerph17051589
15. Laili R, Nashir M. The effect of blended learning by using Edmodo in teaching english for nursing students. Indones J Curric Educ Technol Stud. 2018;6(2):71-76.
16. Alhosban F, Ismaile S. Perceived promoters of and barriers to use of a learning management system in an undergraduate nursing program. Int J Emerg Technol Learn. 2018;13(2):226-252. doi:10.3991/ijet.v13i02.8085
17. Feng JY, Chang YT, Chang HY, Erdley WS, Lin CH, Chang YJ. Systematic review of effectiveness of situated e-learning on medical and nursing education. Worldviews Evidence-Based Nurs. 2013;10(3):174-183.
18. Feng JY, Chang YT, Chang HY, Erdley WS, Lin CH, Chang YJ. Systematic review of effectiveness of situated e-learning on medical and nursing education. Worldviews Evidence-Based Nurs. 2013;10(3):174-183.
19. Emami Sigaroudi A, Kazemnezhad-Leyli E, Poursheikhian M. Compare the effect of two electronic and traditional education methods on first principles of instruction in nursing students of Guilan University of Medical Sciences in 2016. Res Med Educ. 2018;10(1):48-55.

20. Guidelines for Transfusion and Immunohaematology Laboratory Practice. (2016). Australian New Zealand Society of Blood Transfusion.

21. Tinegate H, Birchall J, Gray A, et al. Guideline on the investigation and management of acute transfusion reactions Prepared by the BCSH Blood Transfusion Task Force. Br J Haematol. 2012;159(2):143-153.

22. Salem MS, El-Dakhakhny AM, El-Fiky OAE-F, Mohammed BM. Effect of implementing nursing intervention program on nurses’ knowledge and practice regarding children undergoing blood transfusion. Zagazig Nurs J. 2019;15(1):46-60.

23. Elewa A, Elkattan BAEA. Effect of an educational program on improving quality of nursing care of patients with thalassemia major as regards blood transfusion. Am J Nurs Res. 2017;5(1):13-21.

24. Hugenholtz NI, Croon De, Smits EM, Van Dijk PB, Nieuwenhuijsen K. Effectiveness of e-learning in continuing medical education for occupational physicians. Occup Med. 2008;58(5):370-372.

25. Farshi M, Babatabar Darzi H, Mahmoudi H, Mokhtari Nouri J. Comparison of nursing care learning in air evacuation and transport by lecture and e-learning methods. Jurnal Mil Med. 2012;14(1):27-31.

26. Moazami F, Bahrampour E, Azar MR, Jahedi F, Moattari M. Comparing two methods of education (virtual versus traditional) on learning of Iranian dental students: a post-test only design study. BMC Med Educ. 2014;14(1):1-5.

27. Hashemiparast MS, Sadeghi R, Ghaneapur M, Azam K, Tol A. Comparing E-learning and lecture-based education in control of nosocomial infections. J Payavard Salamat. 2016;10(3):230-238.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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