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Developing a Simulation Problem based Learning (S-PBL) Module and Its Effectiveness in Respiratory Care

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Abstract

Practice-oriented learning is essential in emergency medical Technician (EMT) education to impart the ability to respond to various emergency situations based on major knowledge. The application of S-PBL in connection with simulation allows the improvement in competencies such as problem-solving strategies, skills, and teamwork by providing realism related to the field situation. This study aimed to design a simulation problem-based learning (S-PBL) module on respiratory care cases, intended to be applied to the curriculum for EMT students, and then the effectiveness of the module within the class was analyzed by focus group interview. The module developed in this study was applied to 16 EMT students in their third year at S University in Chungnam who were enrolled in classes opened for the first semester of 2021. Following implementation of the S-PBL module, an additional focus group interview was conducted with five students. The developed module was configured to directly or indirectly evaluate emergency communication ability, emergency patient assessment ability, advanced treatment ability, as well as communication and collaboration ability, and was evaluated through expert consulting formed by the Institute for Innovative Education of S University.Overall class satisfaction was evaluated as high (4.92 out of 5), and the students were determined to have experienced " needs for modification of learning strategy," "self-efficacy," and "cooperative learning" through the class with the S-PBL module.

Keywords: COVID-19, Focus group interview, Emergency medical technician, Simulation, Problem-based learning, Self efficacy, Cooperative learning, Needs for modification of learning strategy

1. INTRODUCTION

Universities are introducing more learner-centered classes to replace traditional lectures and instructor-centered classes. At each university, the Center for Teaching & Learning and the Curriculum Innovation Center analyze curriculum trends and support the use of problem-based learning (PBL), design-based learning (DBL), team-based learning (TBL), and flipped learning teaching methods [1,2].

The Department of Emergency Medical Technician (EMT) trains emergency medical technicians (paramedics) by educating them in professional medical knowledge and practical paramedic skills to help emergency patients. Difficulties can arise as patients encountered within the emergency medical system are associated with complex and diverse health problems, and emergency medical technicians are required to have various practical skills, such as problem-solving ability based on critical thinking, situational judgment, communication skills, teamwork, and attitude [3]. PBL classes provide real or clear context related to the field situation, enabling learners to cultivate problem-solving strategies, skills, and teamwork through both cooperative and self-directed learning, which is suitable for the courses covered by the Department of EMT. Previous studies have also proven the effectiveness of applying PBL to the simulation process for improving clinical performance [4,5,6,7]. Therefore, once learners reach a certain level of knowledge in each subject, it is important to help them improve various competencies through PBL activities.

In the Department of EMT, PBL research was first conducted by S. G. Yoo et al. [8]; other studies include the study by Y. A. Lee et al. [9] on developing and applying PBL to education on basic resuscitation, and the study by H. Y. Pi on developing and applying PBL to education on stroke [3]. However, as all of the

preceding studies have dealt with limited situations in EMT, it is necessary to design a class for developing problem-solving abilities in various emergency situations.

This study aimed to develop a simulation-PBL (S-PBL) module for medical emergencies and practice courses with cases involving patients with problems in their respiratory system. This S-PBL was applied in the form of blended learning for a class of EMT students, and a qualitative survey of satisfaction was conducted in the learner group using focus group interviews (FGI).

2. METHODS

This study developed a S-PBL module for medical emergencies and practice courses, which was applied to 16 EMT students in their third year at S University in Chungnam. All learners completed 48 credits of major subjects, such as basic medicine, patient management and practice, and emergency patient assessment and practice. The developed module was used from Weeks 11 to 14 (16 hours in total) of the 15-week class, and was operated as an offline (face-to-face) class in Weeks 12 and 13, excluding some hours. After class operation, this course was judged suitable for basic certification through expert consulting from the Institute for Innovative Education of S University.

2.1. Module Preparation

The PBL module developed in this study was designed based on the PBL instruction model by Barrow and Myers, as shown in [Table 1][10].

The problem cases and scoring tables for patients with respiratory diseases were prepared through analysis of previous studies, including the development of a PBL module in the Department of EMT through participation in workshops and special lectures held at the Institute for Innovative Education of S University. The problems were designed to be open-ended and authentic. The problems were appropriate for the level of the students taking the class, were problems that students were likely to encounter in the real world, and were those where various solutions could be found. The score sheet was created by modifying and supplementing the simulation evaluation sheet for the assessment and treatment of patients with respiratory diseases obtained during the KALS (Korean Advanced Life Support) Provider course that was developed, certified, and operated by the Korean Association of Cardiopulmonary Resuscitation. In addition, after completing the problem (patient case) and score sheet, the content validity was ensured through evaluation by two professors from the Department of EMT. [Table 2] shows the problem and scoring table of the developed PBL module. The scoring table served as an open behavior guideline as the basis for the evaluation criteria, as well as a detailed guideline for solutions. It was also configured to assess the core competencies of emergency medical technicians proposed by E. S. Choi et al. [11], such as emergency communication, emergency patient assessment, and paramedic care, as well as communication and cooperation, directly or indirectly.

Table 1: PBL curriculum

No.	Learning activities	Remarks
1	**Preparation**	Participating in PBL teaching methods
	Developing a PBL case study & evaluation sheet	
2	**Operation-Module 1**	On & Offline lessons
	Orientation	
	Problem case open & analysis	
	Mini lecture & Skill practice	
	Scenario productions & simulation application	
	Briefing & debriefing	
3	**Evaluation**	Future reflection
	Individual, peer and team evaluation	

Table 2: PBL case study and evaluation sheet

PBL Case study	
You are working in the emergency medical system (119). In May 2021, he arrived at the home of a 70-year-old male patient who reported shortness of breath to 119 as the chief complain. The patient was diagnosed with COPD five years ago and is being treated. The current vital signs are 110/80, 100 times/min, 25 times/min, 36.5°C, and 85% SPO2. You should determine the division of roles of team members as a team leader and evaluate and treat patients. It should be applied to a comprehensive simulation based on discussion and practice on patient assessment (history taking, vital signs measurement, monitoring, triage, etc.) and first aid (oxygen supply, suction, etc.). Team activities should reflect on efficient communication and roles among team members and seek changes in behavior through briefing and debriefing processes. Regarding the operation of the comprehensive simulation, it will be evaluated in the last time, and the following contents are included. 1. Assessment and treatment of each patient to be performed on COPD patients complaining of breathing difficulties 2. Application of simulation 3. Appropriate communication and role between team leaders and team members	
Critical Performance Steps	**Score**
Scene Size up	
1. Check whether the scene is safe to access the patient and whether there are visual cues that provide information about the chief complain.	□1 point □ 0 point
2. Inform that you are the leader and instruct the team member's role (attach monitor, airway management, intravenously secured, etc.).	□2 point □1 point □ 0 point
Primary Assessment	
3. General impression, airway, and breathing are evaluated by comprehensively evaluating the patient's posture, skin color, mental state, and speaking ability.	□2 point □1 point □ 0 point
Secondary Assessment	
4. Investigate SAMPLE history centering on the chief complain and ask questions about OPQRST.	□2 point □1 point □ 0 point
5. Physical examination of the respiratory system is performed in the order of visual examination, palpation, auscultation, and percussion.	□2 point □1 point □ 0 point
6. check vital signs.	□2 point □1 point □ 0 point
7. The patient's condition is evaluated using a pulse oximeter and a capnograph.	□1 point □ 0 point
8. The team members are informed by summarizing the current status of the patient and listen to the team members' opinions.	□2 point □1 point □ 0 point
Patient Care	
9. Depending on the patient's condition, oxygen apply using appropriate equipment.	□2 point □1 point □ 0 point
10. Get online medical control, choose the right drug and apply nebulizer.	□2 point □1 point □ 0 point
11. Monitor the patient's response to the drug (re-assessment of the patient's condition).	□1 point □ 0 point
12. Select the hospital to be transferred according to the patient's condition and contact them.	□1 point □ 0 point
• Team : • Score : Total point /20 point • Score criterion: It is evaluated as 2 points for accurately implementing all, 1 point for insufficient performance, and 0 point for incomplete or incorrect implementation or error.	

2.2. Class Operation

In the class operation stage, mini lectures and skill practice opportunities were provided, allowing a team of four to five people to perform the problem-solving process faithfully. This process was intended to induce learning about the assessment and treatment that could be used during the final simulation, which

included primary and secondary assessment of patients with respiratory diseases, the use of equipment to monitor the patients, the method of administering oxygen, the method of using a nebulizer, and the securing of an intravenous route. After that, through team discussions, the necessary content for scenario writing and simulation production was obtained. Before creating the final simulation, the instructor was able to revise and supplement the scenario to make sure that it did not deviate from the learning goal. In the last class, the produced simulation video was briefed and debriefed by each team, followed by self-evaluation, peer evaluation, and team evaluation.

2.3. Focus Group and Analysis

A qualitative study using FGI was additionally conducted for a group of five learners in order to evaluate the effectiveness of the PBL class operation. The survey items were verified to be appropriate by two professors experienced in qualitative research, and the contents included: “How was your non-face-to-face class?”, "What was your PBL class experience?", and "Is the PBL class helpful in acquiring the learning contents of medical emergencies and practice courses?" The interview was recorded with the consent of the participants and transcribed (in text). Then, the transcript was used for the analysis, where the contents of the interview were categorized and analyzed repeatedly. In order to increase the reliability and validity of data analysis and interpretation, a discussion with two professors from the Department of EMT experienced in qualitative research was conducted.

3. RESULTS AND DISCUSSION

3.1. Class Evaluation and Reflection

After the team activity and presentation, self-evaluation, peer evaluation, and team evaluation were conducted. The evaluation sheet was prepared with specific evidence presented, and the instructor was able to confirm the role and contribution of team members once again based on the evaluation sheet. As a result of the class satisfaction survey, scored on a 5-point scale, the intermediate evaluation score for the lecture-style class was 4.76, whereas the class satisfaction score increased by 0.16 points to 4.92 points after applying the PBL module [Table 3]. It was beneficial to integrate the knowledge learned through PBL activities and to reconstruct and operate it in a real situation, with the learners themselves confirming that their problem-solving ability and various major competencies overall improved.

Table 3: Results of a class satisfaction survey after the application of the PBL module

	Question	Score
Basic item	I thoroughly prepared for the class and actively participated in the class.	4.88
Class	The class met the objectives and proceeded according to the syllabus.	4.88
	The professor thoroughly managed the class.	4.88
	The professor led the class with enthusiasm.	4.88
	The professor faithfully answered the students' questions.	4.94
	The professor encouraged the students to actively participate in the class.	4.94
	The content of the class was at an appropriate level of difficulty for the students.	4.94
Evaluation	In the class, reasonable evaluation criteria and an evaluation method for grades were used.	4.94
	The assignments and tests were helpful for understanding the content of the class.	4.94

Satisfaction	This class was helpful for understanding the concepts and principles of the field.	4.94
	The class was helpful overall.	4.94
Average class satisfaction		4.92
Other narrative evaluation In the class, I was able to acquire emergency internal medicine-related knowledge such as the respiratory system, nervous system, and digestive system in detail. In particular, I was confused about how to properly classify diseases with dyspnea as the main symptom, while feeling that there are a lot of diseases associated with dyspnea in the respiratory system. It was really helpful to go through the triage method for dyspnea patients on my own while writing a scenario related to dyspnea in the offline class. It was also helpful to learn new things such as defibrillation and intravenous injections that I had not been able to learn before through practice.		

3.2. Class Effectiveness Analysis through FGI

The effectiveness of class operation with the developed PBL module was evaluated by a qualitative study using FGI with five learners. The analysis revealed that the students experienced a "needs for modification of learning strategy," "self-efficacy," and "cooperative learning" through the class with the S-PBL module. Furthermore, the learners were determined to have experienced “improvement of learning concentration” and “reduction of participation in class” with “non-face-to-face” class.

3.2.1. PBL class experience

A. Needs for Modification of Learning Strategy

Lecture-oriented classes induce learners to simply memorize large amounts of knowledge, leading to a failure to provide sufficient time to integrate and apply the related knowledge. There is a limit to connecting and applying the knowledge in real situations. In fact, students were thinking about learning methods that could merge and apply related knowledge rather than passive learning.

Student 1: *I have a similar opinion with Sun-kyung. It would be important to think,*

“This symptom may indicate this disease,” and think about what measures can be taken.

Student 2: *I studied the characteristics of diseases and the emergency treatments separately. However, it seemed beneficial to study the characteristics of diseases and the required emergency treatments according to this flow.*

Student 3: *Rather than trying to memorize the theory, we would have to study what would help patients or what patients need when we encounter them.*

B. Cooperative Learning

In the problem-solving process, the cooperation of team members is emphasized. As PBL deals with open, complex, and unstructured problems, there may be differences in how each learner accepts the learning process [12]. However, appropriate team activities can have a positive effect on learning strategies and learning outcomes [12,13]. In this study, learners also felt that learning outcomes could be achieved through team activities.

Student 4: *I was able to practice better by sharing opinions with my friends, which was helpful*

Student 1: *Yes, it would have taken me longer without my teammates. We discussed it together to figure out how to do it. I could not have done it alone.*

C. Self-Efficacy

Previous studies have reported the positive effect of PBL classes on self-efficacy. Self-efficacy refers to the beliefs, personal thoughts, and self-confidence of students in their ability to solve a given problem. Self-

efficacy increases achievement motivation, persistence, and proactivity when performing tasks [14,15]. In this study, it was also possible to observe the improvement in the self-efficacy of learners.

Student 3: *Rather than focusing on the theory, we could talk and pitch our opinions once in a while, and the leader synthesized them to make the final results. This made us proud of the outcome and motivated us to speak out more in subsequent group projects.*

Student 1: *Team members really encouraged me to talk and learn more by saying, "Sounds good," or "It seems to be a good opinion."*

3.2.2. Non-Face -To-Face Class Experience

The non-face-to-face class in this study was operated in a mixture of two formats: a Zoom-based real-time class and a pre-filmed video lecture. In the Zoom-based real-time classes, small group discussions could be set up, allowing team discussions that were not possible in face-to-face classes. In the mini lectures, pre-filmed videos were uploaded to the learning management system (LMS) to allow repeated learning without time and space restrictions.

A. Improved Learning Concentration

The learners in the PBL class said that they liked the presentation class conducted via Zoom, especially in the last week, as it provided for high concentration and less tension and burden. Conducting a presentation in the classroom may cause difficulties in viewing presentation materials from the seats in the back rows. On the other hand, online presentations provided the benefit of viewing the presentation materials directly in front of the learner on mobile devices or personal computers, allowing the students to better focus on the presentations. Also, the presenters said that they could proceed with their presentation more smoothly and with less burden and tension compared to giving a presentation in front of the audience in the classroom.

Student 1: *There are people who feel more burdened with presentations. However, I was less nervous when I gave my presentation via Zoom, which also allowed me to add any materials needed right away when preparing them.*

Student 3: *As for the presentation, I could focus better when I looked directly into the monitor than when I watched it from here (in the classroom). Watching the presentation on the monitor made me focus better.*

Student 1: *The use of Zoom seems to have been more convenient for both the presenter and the listener.*

B. Decreased Participation

As for team activities conducted in the small group room via Zoom, there were difficulties in communication as a rapport had not been formed among the team members. The prolonged non-face-to-face classes created limited opportunities for the formation of relationships between classmates, and seniors and juniors. In the initial stage of the actual team activity, it was confirmed that smooth communication between learners was not achieved.

Student 3: *Via Zoom, there were people who did not participate much.*

Student 2: *Depending on the personality of people, the participation rate seems to be lower via Zoom.*

4. CONCLUSIONS

This study is conducted by adapting simulation problem based learning (S-PBL) to medical emergencies and practice courses with the cases of dyspnea patients intended to be applied to the curriculum for Emergency Medical Technician (EMT) students, and aims to analyze the effectiveness of the module within the class with focus group interview.

The developed S-PBL module was designed to solve the problem by focusing on major emergency cases with mini-lectures and team discussions. Also it is designed to directly and indirectly evaluate the skills of communication and cooperation, as well as the emergency communication ability, emergency patient assessment

ability, and advanced treatment ability, that are the core competency of EMT proposed on the report by Choi [10]. The developed module was certified through expert consultant formed by the Institute for Innovative Education of S University.

It was analyzed that learners experienced the 'needs for modification of learning strategies', 'self-efficacy', and 'cooperative learning' through classes using the S-PBL module developed in this study. And the overall class satisfaction shows a high level as 4.92 points.

Emergency situations experienced by EMT require various competencies such as problem-solving ability based on critical thinking, situational judgment, communication skills, and attitude. This improvement in competency was found in the teaching method using S-PBL. Despite the limitation of this study, various competencies and learning outcomes would be proven through multi-faceted research for the effective operation of S-PBL classes in the Department of EMT in the future

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