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Research Article

The Effect of Training Based on the SCORPIO Model on the Knowledge and Skills of Airway Management Peri-Anesthesia Induction in Undergraduate of Nursing Anesthesiology Students

Masoumeh Albooghobeish[1], Zinat Mohamadi[1]*, Ali Khalafi[1], Morteza Habibi Moghadam[2]

[1]Department of Anesthesology, School of Allied Medical Sciences, Ahvaz Jundishapur Univercity of Medical Sciences, Ahvaz, Iran.

[2]Department of Anesthesiology, School of Allied Medical Sciences, Dezful University of Medical sciences, Dezful, Iran.

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ABSTRACT

Background: Using novel educational methods in teaching medical sciences is very important. The SCORPIO model is one such method that can be used as an interactive educational station and a combination of other educational methods. The purpose of this study was to determine the effectiveness of the SCORPIO model in the acquisition of knowledge and skills of airway management during peri-anesthesia induction among undergraduate nursing anesthesia students.

Methods: The present study was a randomized controlled study with a pre-test-post-test design including an intervention and a control group. The participants were undergraduate nursing anesthesia students studying in the 3rd and 5th semesters. Sixty students were selected using convenience method and were randomly assigned to intervention and control groups. In order to collect data, a researcher-made questionnaire was used to assess the students' knowledge and an OSCE test to assess their skills. The intervention group attended three 2-hour training sessions where the knowledge and skills of airway management during peri-anesthesia induction was taught using the SCORPIO model. The control group, on the other hand, received the same content through conventional teaching methods including lectures and the use of manikins in three 2-hour sessions.

Results: There was no statistically significant difference between the two groups in terms of demographic characteristics ($p<0.05$). The mean score of students' knowledge of airway management during peri-anesthesia induction before the intervention was (1.83) 12.47 in the intervention group and (1.71) 12.63 in the control group. Also, the mean score of students' skill of airway management during peri-anesthesia induction before the intervention was (1.44) 12.07 in the intervention group and (1.43) 12.43 in the control group, which indicated no statistically significant difference according to independent t-test ($p=0.71$ and $p=0.32$, respectively). After the intervention, however, the results of the paired t-test showed a statistically significant difference between the two groups in terms of the knowledge and skill scores, with the students in the intervention group obtaining higher scores of knowledge and skills ($p<0.001$), while this was not the case in the control group ($p=0.26$ and $p=0.64$, respectively).

Conclusion: The SCORPIO model improves the knowledge and skills of airway management peri-anesthesia induction in undergraduate nursing anesthesia students.

The authors declare no conflicts of interest.

*Corresponding author.
E-mail address: zinat8842@gmail.com

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Introduction

Every year, many patients require airway management and a safe airway for a variety of reasons. There are several methods for airway management and respiratory support including: airway management using face mask, laryngeal mask, endotracheal intubation, and tracheostomy [1]. Airway management during peri-anesthesia induction is very important since it is one of the most important care interventions that can lead to saving the lives of patients. Therefore, the teaching of this skill is of paramount importance [2-3].

Nurse anesthetists are the first to help patients in critical situations, and if they are not able to perform the necessary interventions to manage the airway correctly, accurately, and with sufficient speed, the possibility of patient harm and loss of golden time for saving the patient increases. Therefore, undergraduate nursing anesthesia students should strengthen their skills before facing patients in clinical settings, because only by acquiring these skills along with sufficient knowledge, will their competence increase in caring for patients [4-5].

In the meantime, the most important output of educational centers is to cultivate caregivers with the highest quality to provide clinical services to clients. Accurate, principled and fact-based clinical training should start from the very beginning of the students' studies and continue throughout their clinical education. In this way, it will bring better and more stable results. Therefore, the adoption of measures and methods for teaching clinical skills, including airway management during peri-anesthesia induction, in correct and effective ways should be taken into serious consideration [6-7]. Many different methods can be used to teach airway management during peri-anesthesia induction, and one of them is the SCORPIO model [8].

The SCORPIO model is a medical education system developed by David A. Hill in 1992. Lack of an integrated curriculum and inappropriate examination systems were two of the deficiencies that led to the development of this educational model which was aimed to produce competent clinical graduates. This model was first used to teach third- and fourth-year medical students, but it has the potential to be used in lower levels and in allied medical sciences and other clinical fields as well [8]. SCORPIO stands for structured, clinical, objective-referenced, problem-based, integrated, and organized [9].

The SCORPIO model can be used to teach cognitive, psychomotor, attitudinal, emotional skills, or a combination of them. This model allows students to learn knowledge, practice skills, and simultaneously receive feedback on their performance [10]. SCORPIO is an interactive and hybrid teaching method that is based on participation and has a framework with three essential components: interactive and educational stations, displaying written learning objectives at the stations, and receiving feedback during rotation between the educational stations [11].

In the SCORPIO model, students are divided into small groups after an introductory lecture. Small group training can be more effective compared to educational lectures. It can increase interaction and participation between teachers and students, strengthen students' communication skills, and promote their teamwork and peer-learning [12]. Also, the use of different and diverse educational methods in the stations boosts the attractiveness and dynamics of the educational session and encourages students to have active, interactive, and sustainable participation [10-13].

In interactive education, which is one of the important features of the SCORPIO model, in addition to the teacher having an active role and presenting the material to the student, the student also has a central role and actively participates in the discussions and asks their questions about the material and receives answers from the teacher or other students. This engages the student's mind and thinking in the discussion and leads to enhanced learning, empowered thinking, and improved level of students' knowledge [14-15].

Few studies have been done on the SCORPIO model. In the study of Sara et al. (2021) in Ireland, it was concluded that the use of the SCORPIO model in combination with other training methods to train maternity staff about perinatal bereavement care can be very effective and lead to the satisfaction of bereaved parents [16]. Also, Jeffery et al. (1996) conducted a study among fifth-year medical students in Australia with the aim of comparing the SCORPIO model with the lecture method in terms of newborn examination and resuscitation. They found that the SCORPIO model is the better option because of its high diversity and active participation of students, which leads to adequate mastery of a range of competencies and skills in newborn care [17]. Ahern et al.'s (2011) study in Australia also showed that using the SCORPIO model can improve knowledge and clinical skills as far as pediatric radiation oncology is concerned, but more research is needed to prove this [18].

Effective learning of airway management during peri-anesthesia induction is of paramount importance in undergraduate nurse anesthesia students who play a significant role in safe anesthesia and taking care of the health and safety of patients, and the SCORPIO seems to be an efficient model for this purpose. However, there is paucity of sufficient studies on this educational model. Therefore, this study was conducted to investigate the effect of training based on the SCORPIO model on the knowledge and skills of airway management during peri-

anesthesia induction among undergraduate nursing anesthesia students.

Methods

This was a randomized controlled study with a pre-test and post-test design to investigate the effect of training based on the SCORPIO model on the knowledge and skills of airway management during peri-anesthesia induction in undergraduate nursing anesthesia students studying in the 3rd and 5th semesters at Dezful University of Medical Sciences, Iran. The study was conducted in the first semester of the academic year 2023-2024.

Selection of participants was done in several stages using convenience sampling method. In the first stage, a briefing session was held for undergraduate nursing anesthesia students. In this meeting, the study objectives and procedures (which included the number of training sessions, the duration of each session, and the pre-test and post-test process) were explained to the students. The students were also ensured that participation and cooperation in this study was completely optional and that all their personal information and grades would remain confidential. Undergraduate students of nurse anesthesia studying in the 3rd and 5th semesters who were willing to participate in the research and had full cooperation in the implementation of the intervention were eligible to enter the study. Exclusion criteria were: unwillingness or refusal to participate in the research at any time of the research, absence in more than one training session, having a clinical work experience, or passing any additional training courses on airway management. Finally, 60 undergraduate students of nurse anesthesia studying in the 3rd and 5th semesters who met the inclusion criteria, signed the informed consent form and entered the study. A random number table was used to divide the students into intervention and control groups (n=30 each). The allocation ratio of the samples was (1:1).

In the second stage, in order to carry out the pre-test, a demographic profile form and a questionnaire to evaluate the knowledge of airway management during peri-anesthesia induction were given to the students of the intervention and control groups to complete. They were given 20 minutes to complete the 20-question questionnaire. Also, the OSCE test was administered to examine the airway management skills of the students from both groups. This test was conducted in the skill lab and included 4 stations designed by the research team. These included the skills of oropharyngeal airway placement, masking, intubation and its fixation, and laryngeal mask airway (LMA) and its fixation. One evaluator was assigned to each station. Nurse anesthetists with more than 5 years of clinical work experience and mastery of airway management methods were eligible to be selected as evaluators. The evaluators selected in advance by the research team participated in a meeting and were briefed on how to complete the checklists, and their ambiguities were resolved. Students had between 5 and 10 minutes at each station, depending on the desired skill. In order to avoid skewing the results, each of the students entered the skill lab individually and performed the skills of all 4 stations under the supervision of the evaluator in order to conceal their performance from other students. They then went into an isolated room and rested to avoid contact with other students until the end of the pre-test.

In the third stage, after the pre-test was administered, training sessions based on the SCORPIO model were held for the intervention group: 3 sessions, 2 hours each, continued for 3 weeks. The educational content of these sessions was related to the knowledge and skills of airway management during peri-anesthesia induction. The content of each session was as follows: the first session: masking and ventilation procedure; the second session: LMA procedure; and the third session: laryngoscopy and intubation procedure. In each session, after a short 20-minute lecture about the content of the session and its importance, the students were divided into 5 groups of 6 (i.e., 3 3rd-semester students and 3 5th-semester students). Then, each group rotated between 6 educational stations that were designed and prepared by the research team. For more effective training and saving time, a nurse anesthetist, who had been familiarized with the teaching method and contents of the station by the research team before the start of the training session, was assigned to each station. The members of the research team supervised the entire student performance in the skill lab hall and fixed any possible problems. In each station, the educational objectives of that station were included and installed on a board to clarify the educational content of the station. As far as educational content was concerned, different educational methods were used in the stations, including simulation, role playing, lecture, group discussion, and peer learning. The aim was to maintain student interaction, which is one of the important features of the SCORPIO model. Also, pictures, educational video-clips, and manikins were used for theoretical and practical training to make the material more concrete for the students. The simulation method was implemented in such a way that a clinical situation was simulated using a manikin so that students could better understand the conditions of a real clinical situation. Then, under the supervision of the nurse anesthetist, the students practiced the desired skill and received feedback simultaneously. To use the role-playing method, the nurse anesthetist would choose one of the students to play the role of a hypothetical patient so that the students could experience more interaction in a more realistic clinical situation. Then the nurse anesthetist would provide the necessary explanations to them, and the students would practice accordingly. Finally, another student would assume the role of a patient so that all students could practice the role-playing, and the training would be the same for all of them. In the

lecture method, the desired material was explained to the students by the nurse anesthetist in form of a lecture, and for more effective learning, educational aids such as masks, tracheal tubes, laryngoscope blades, LMA, and educational videos were used. The group discussion method which was aimed to increase the interaction and activity of the students involved the nurse anesthetist raising a question related to the educational goals included in the station and asking the students to have a discussion in order to reach the answer to that question. The nurse anesthetist directed their discussion so that they would not deviate from the main topic. Also, she sometimes used relevant printed images to guide their discussion. Due to the presence of 3rd- and 5th-semester students in each group, the peer learning method was implemented in such a way that the 5th-semester students who had more experience taught the 3rd-semester students the educational content of that station according to the goals listed in the station under the supervision of the lead nurse anesthetist. This maintained interaction between group members and promoted the quality of learning. The teaching methods used in the stations are listed in Table 1. According to the educational content of each station, the groups were trained for 5 to 15 minutes at each station. Due to the fact that the students were constantly interacting and practicing, they were given the necessary feedback at the same time as they were receiving the training. The control group learned the same educational content in three 2-hour sessions continued for 3 weeks in form of routine and conventional training, i.e., lectures and clinical exercises in classrooms and the skill lab.

In the fourth stage, one week after the last training session, a post-test of the knowledge and skills of airway management during peri-anesthesia induction, identical to the pre-test, was administered to all students of the intervention and control groups. It involved a questionnaire to check the students' knowledge of airway management during peri-anesthesia induction and an OSCE test to check the students' skills in this regard.

The tool used in this research included two sections: The first section was a researcher-made questionnaire including 20 test questions to evaluate knowledge of airway management during peri-anesthesia induction, which was developed after using the latest references, sources and available articles [19-20]. Each question had only one correct answer, which received a score of 1 if the answer was correct, and a score of zero otherwise.

The second section of the instrument was an OSCE test to assess airway management during peri-anesthesia induction. This test, which included 4 stations, was developed by the research team to evaluate students' practical skills. The minimum score obtained in both knowledge and skill tests was zero and the maximum score was 20. A score between 0 and 4 indicated very weak level of knowledge and skill of airway management during peri-anesthesia induction, a score of 5 to 9 was considered weak, a score of 10 to 14 was moderate, and a score of 15 to 20 was considered excellent. Content validity and face validity of the questionnaire were checked to confirm the validity of the instrument. To this aim, the tools were provided to 10 members of the faculty members of the Nursing Anesthesia Department and Anesthesiology Department, and their comments and opinions were sought. As far as content validity was concerned, the three components of relevance, fluency and clarity of each item were discussed, and with regard to face validity, the form, expressiveness, and wording of each item were scrutinized. The results were as followed: CVI=83 and CVR=86. Then the suggestions and corrections were collected and applied after discussion with the research team, and the validity of the instrument was confirmed. In order to check the reliability of the questionnaire, the internal consistency of the instrument was measured by calculating Cronbach's alpha coefficient. To this aim, the questionnaire was completed by 10 students who met the inclusion criteria but were not part of the final participants of the study, and then its Cronbach's alpha coefficient was calculated to be 0.7. The reliability of the OSCE test stations was also checked through simultaneous observations by two separate raters, and the inter-rater correlation coefficient was calculated. The range of the correlation coefficient of the stations was between 0.81 and 0.96. Fisher's exact test, chi-square test, and independent and paired t-tests were used for data analysis in SPSS version 26. The significance level was set at $p< 0.05$. Results of the Smirnov-Kolmogorov test showed that the distribution of data of knowledge and skills before and after the intervention was normal ($p<0.05$). Therefore, parametric tests were used to compare variables.

Table 1- Educational content and educational methods used in the stations

Educational methods	Educational content of the station
Lecture and use of various masks	Choosing the right mask size
Role-playing	Masking method
Simulation	Difficult masking method (2 people)
Lecture	Pre-oxygenation
Peer learning	Airway installation
Group discussion	Complications of masking and airway installation
Lecture and using LMA	Introduction to LMA and when to use it
Peer learning	Checking LMA and making sure it is working properly
Lecture and using LMA types	Choosing the right LMA size
Simulation	LMA method
Group discussion	LMA fixation

Peer learning	Post-operative complications of LMA for the patient
Lecture and use of various tracheal tube sizes	Choosing the right size of tracheal tube
Lecture and use of different sizes of laryngoscope blade	Choosing the correct size of laryngoscope blade
Simulation	Laryngoscopy and intubation
Lectures and use of educational videos	Sellick and BURP maneuvers
Group discussion	Tracheal tube fixation
Group discussion and the use of educational images	Difficult cases

Results

This study encompassed 60 participants, evenly split between the intervention and control groups, 30 each. The control group included 18 females and 12 males, while the intervention group had 17 females and 13 males. Within the control group, 17 participants were studying in the 3rd semester, and 13 in 5th semester. In the intervention group, there were 15 students studying in the 3rd semester and 15 in the 5th semester. Notably, no statistically significant differences were observed between the two groups in terms of gender (P=0.793), semester (P=0.796), GPA (P=0.583), and age (P=0.576) (Table 2).

The results show that before intervention there was no significant difference between the two groups in terms of knowledge of airway management during peri-anesthesia induction (P=0.717). However, after intervention, the intervention group obtained significantly higher scores of knowledge of airway management during peri-anesthesia induction scores than did the control group (P<0.001). Similarly, before the intervention there was no significant difference between the two groups in terms of the skill of airway management during peri-anesthesia induction (P=0.326). However, after intervention, the intervention group had significantly higher scores of skill of airway management during peri-anesthesia induction than did the control group (P<0.001) (Table 3).

The findings demonstrate that within the control group there was no significant difference in the scores of knowledge of airway management during peri-anesthesia induction before and after the intervention (P=0.269). However, a significant increase was observed in the scores of the knowledge of airway management during peri-anesthesia induction within the intervention group after the intervention (P<0.001). Similarly, within the control group, no significant difference was seen in the scores of the skill of airway management during peri-anesthesia induction before and after the intervention (P=0.647). Conversely, within the intervention group, a in the scores of the skill of airway management during peri-anesthesia induction scores increased significantly after the intervention compared to before intervention (P<0.001) (Table 4).

Table 2- Frequency (percentage) of demographic information of participants in control and intervention groups

Variables		**Control**	**Intervention**	**Total**	**P value**
Sex	Female	18(30%)	17(28.3%)	35(58.3%)	0.793
	Male	12(20%)	13(21.7%)	25(41.7%)	
Semester	3	17(28.3%)	15(25%)	32(53.3%)	0.796
	5	13(21.7%)	15(25%)	28(46.7%)	
GPA	14-16	7(11.7%)	4(6.7%)	11(18.3%)	0.583
	16.1-18	18(30%)	19(31.7%)	37(61.7.0%)	
	18.1-20	5(8.3%)	7(11.7%)	12(20.0%)	
Age	18-20	10(16.7%)	11(18.3%)	21(35%)	0.576
	21-22	15(25%)	17(28.3%)	32(53.3%)	
	23-25	5(8.3%)	2(3.3%)	7(11.7%)	

Table 3- Results of independent t-test

Variables		**Control**			**Intervention**		**P value**
		mean	**SD**		**mean**	**SD**	
Knowledge	Before	12.63	1.71		12.47	1.83	0.717
	After	12.86	1.59		16.13	1.66	<0.001
Skill	Before	12.43	1.43		12.07	1.44	0.326
	After	12.53	1.57		15.83	1.70	<0.001

Table 4- Results of paired t-test

Variables		Before			After		P value
		mean	SD		mean	SD	
Knowledge	Control	12.63	1.71		12.86	1.59	0.269
	Intervention	12.47	1.83		16.13	1.66	<0.001
Skill	Control	12.43	1.43		12.53	1.57	0.647
	Intervention	12.07	1.44		15.83	1.70	<0.001

Discussion

The present study compared the effect of training based on the SCORPIO model versus conventional training on the knowledge and skills of airway management during peri-anesthesia induction in undergraduate nursing anesthesia students. The results showed that the mean scores of the pre-test did not have a statistically significant difference between the intervention and control groups, which was expected due to the homogeneity of the participants in the two groups. Also, comparing the mean scores of the pre-test and post-test in the control group did not show any significant difference, which could be due to the use of the conventional training method in this group because the teaching method used in the control group was teacher-centered and the students did not have much activity and participation in their learning. Also, the educational concepts were only conveyed to them by the teacher, and the students were simply passive recipients. This reduced the students' motivation and interest and prevented them from trying to learn more. The ultimate outcomes of such education will be students who do not have the ability to integrate knowledge and skills for provision of professional services to patients, and as a result, the quality of patient care will decrease, and their health and safety will be endangered. According to Huo Lin Zeng et al. (2020), the use of conventional teaching methods compared to other interactive teaching methods produces lower quality learning because the students' task is only to listen to the material that the teacher teaches and do the assignments that the teacher assigns, so they themselves have no role in the learning process [21]. Also, the very slight increase in the post-test scores of the control group can be explained by the intervention training sessions and the training that they received in their university courses at the same time. This is because the training sessions held for them by the research team were similar to their conventional and routine training and had a very small effect on the improvement of their knowledge and skills.

Our comparison of pre-test and post-test scores of the intervention group showed a significant difference, which indicates the role of the SCORPIO model in significantly improving the level of students' knowledge and skills. The implementation of the SCORPIO model by the research team involved training sessions designed in a dynamic and interactive way, and the students had an active role in their learning and were frequently engaged in exchanging information with the instructor and other students. This enhanced the quality of learning the knowledge and skills of the airway management in these students. Huynh et al. (2021) argued that the use of the SCORPIO model led to improved learning of anatomy and autopsy procedures in senior medical students [22]. Janet et al. (2012) found that training based on the SCORPIO model leads to an increase in the quality of teaching complex clinical guidelines to interprofessional caregivers who are in charge of caring for pregnant women [15]. The results of these studies are consistent with ours, indicating that the SCORPIO model can lead to the improvement of knowledge and skills in patient care. As the results of the present study showed, the use of this educational model boosts the scores of knowledge and skill of airway management among undergraduate nursing anesthesia students. It can educate caregivers who will provide better and more professional services to patients during peri-anesthesia care induction, which is a very sensitive and important period.

According to Gibson et al. (2022), the use of cooperative and interactive educational methods can improve clinical knowledge and skills, increase self-confidence, and reduce students' anxiety and stress [23]. Using the SCORPIO model can also reduce stress and increase students' motivation to learn since instead of being just listeners, they actively participate in the learning process and consider themselves responsible for their own learning. Also, during the intervention in our study, they freely asked their questions and talked about the skills. In addition, the group members helped each other to understand the content better, and since a friendly partnership was established between them, their stress was well controlled. As Ghezzi et al. (2021) confirmed in their study, using the method of active participation in education not only strengthens students' motivation to learn and improves the communication between lecturers and students but also promotes their clinical reasoning skills and decision-making ability [24].

On the other hand, it was confirmed in Van Diegel et al. (2020) that distributing students into small groups under the SCORPIO model leads to strengthened teamwork, increased teacher's attention to the individual needs of students, and responding to them according to their needs [13]. In the present study, since there were 6 students in each group and each group rotated separately in different stations, and thanks to the small number of

students in each group, the lead nurse anesthetist in each station was more focused in identifying the students' problems and could give more efficient feedback to the students to solve them. Mestre et al. (2022) also reported that directing and guiding of small groups of students by the instructor provides the right opportunity to analyze the weaknesses and strengths of the students by themselves, and this can put them in the right path of learning and increase the quality of their learning [25]. In our SCORPIO model, since students were divided into small groups, not only could the nurse anesthetist guide them with better quality and give them feedback, but the students also had more focus and opportunity to find their weaknesses and strengths and practice accordingly.

Creating diversity in education by using different educational methods is one of the unique characteristics of the SCORPIO model, which was implemented in the educational stations in the present study. The educational content was divided between 6 stations, and a teaching method was chosen for each station according to its educational content. Despite its time-consuming nature, this led to the development of diverse and attractive stations that attracted the attention of students. Zhao et al. (2020) compared lecture method with integrated teaching among fourth-year medical students at the clinical stage. They concluded that the use of different and diverse teaching methods can improve students' grades and improve their performance and clinical skills [26]. As in the present study, the use of various educational methods in educational stations made the educational concepts attractive for students and ultimately led to an increase in the quality of learning and better stabilization and retention of concepts in their minds. The results of Lockey et al. (2022) also lend support to the results of the present study and indicate an increase in the quality of learning following the use of various educational methods and shifting from a teacher-centered approach to a learner-centered one [27].

The above-mentioned studies are different from the present study from various perspectives such as the study setting, the target group, the intended procedure, and even the duration of the research. In addition, due to the increasing progress of using new and diverse educational methods, the SCORPIO model was used in this study, which can boost students' interaction and participation in a training session. Since different educational methods and different equipment were used in the stations, students' learning was enhanced, their attention was more attracted to the educational content, their motivation was elevated, and a more effective communication was established between the lecturer and the student. These outcomes can make a significant change in the education, care and treatment system because they may lead to the better performance of the anesthesia team in future and increase the quality of patient care, which will in turn result in patient satisfaction.

One of the limitations of the present study was the possibility of information exchange between the control and intervention groups. To control this, an attempt was made to hold the training classes of both groups on different days to minimize the possibility of information exchange. Also, coordinating the evaluators of the educational stations and designing the stations affected the speed and progress of the study. Future studies on the use of the SCORPIO model are recommended to teach other courses of nursing anesthesia or recruit students of other fields of medical sciences.

Conclusion

The final results of the present study showed that the use of the SCORPIO model is effective in improving the knowledge and skills of airway management during peri-anesthesia induction among undergraduate nursing anesthesia students. Also, this study can help the professors and instructors of anesthesia departments to decide and choose teaching methods or to integrate them with other conventional and traditional methods depending on the learning situation. Since the professors and instructors involved in the education of students must always keep their knowledge and skills up to date, it is suggested that they become more familiar with the SCORPIO model and benefit from its advantages. Considering the effectiveness of this educational method in increasing the knowledge and skill of airway management during peri-anesthesia induction among undergraduate nursing anesthesia students, it is suggested that this method be incorporated as a part of the official curriculum of the undergraduate nursing anesthesia students. This model can also be used in educational workshops.

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