

# World Journal of *Clinical Cases*

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Prospective Study

# Effectiveness of the combination of workshops and flipped classroom model to improve tube fixation training for nursing students

Yu-Cui Wang, Hui-Lin Cheng, Yu-Mei Deng, Bao-Qi Li, Xue-Zhen Zhou

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## Abstract

### BACKGROUND

Tube indwelling is a key procedure in modern medicine. Careful tube setup is necessary to prevent unplanned extubation. The training for tube fixation is time- and resource-consuming, and optimal modes of training are currently being sought. Previous studies have compared workshops and flipped classroom models separately using conventional teaching strategies, but no study has examined a combination of both teaching models in nursing training.

### AIM

To compare the effectiveness of workshops *vs* workshops combined with the flipped classroom model for improving tube fixation training for nursing students.

### METHODS

This was a prospective cohort study. In this study, 149 nurses who joined our hospital in 2019 underwent training using workshops combined with the flipped classroom model (experimental group), while 159 nurses who joined the hospital in 2018 received only workshop-based training (control group). The combination of workshops with the flipped classroom training model was divided into two

modules: pre-class and in-class training. The participation of nurses in the training activities, on-site assessment of training, nurses' evaluation of their training, and related indicators of tube quality management were evaluated.

## RESULTS

The average age of nurses in the control group was  $22.94 \pm 0.94$  years and that of nurses in the experimental group was  $25.42 \pm 3.23$  years ( $P < 0.01$ ). The qualified rate of after-class assessments for the experimental and control groups was 100.00% (average score:  $94.01 \pm 2.78$  points) and 91.82% (average score:  $84.24 \pm 2.94$  points), respectively ( $P < 0.01$ ). Most nurses in the experimental group completely agreed that the combined training was helpful to cultivate clinical thinking and independent learning ability and to master knowledge of tube fixation. In addition, the training content within the pre-class teaching video, pre-class tube atlas, pre-class main instructor guidance, in-class demonstration, and in-class practice was very informative. The experimental group had higher evaluation scores than the control group ( $4.88 \pm 0.38$  vs  $4.67 \pm 0.64$ ;  $P < 0.01$ ). Comparison of tube quality management before and after training in 2018 to 2019 revealed that the unplanned ureteral tube removal rate dropped from 0.25‰ to 0.06‰, the unplanned chest tube removal rate dropped from 1.07‰ to 0.78‰, and the unplanned gastric tube removal rate dropped from 0.36‰ to 0.17‰. The incidence rate of pressure ulcers caused by the tube decreased from 0.78‰ to 0.45‰.

## CONCLUSION

The combination of workshop and flipped classroom training is effective in improving tube fixation training of nurses, cultivating nurses' active learning abilities and clinical thinking, and improving the safety of the procedure.

**Key Words:** Flipped classroom teaching; Nursing; Tube fixation; Workshop

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**Core Tip:** This was a prospective study, in which 149 nurses participated in a new skill-training method for tube fixation training. The workshop combined with flipped classroom training was helpful in improving tube fixation training, cultivating nurses' active learning abilities and clinical thinking, and improving the safety of the procedure.

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## INTRODUCTION

Tube indwelling is a key and complex procedure in modern medicine. It is a vital means and basis for treatment, observation, and prognosis of patients[1,2]. Unplanned extubation (UEX) refers to extubation intentionally caused by patients or by accident and one that is not planned by a healthcare worker[1-3]. Careful tube setup is necessary to prevent UEX[1,2], which requires appropriate training. Proper training is time- and resource-consuming, because tube indwelling is an invasive procedure and cannot be performed without adequate practice by student nurses or healthcare workers. Hence, optimal training models are being currently sought.

At present, the most effective approaches for learning medical techniques are eagerness of the trainees to learn the material, active participation of the students in class, and collaboration with classmates and instructors[4-6]. The workshop model first appeared during research in the field of education and psychology. It is a participatory, experiential, and interactive training model that can enhance the interest and enthusiasm of the participants to learn techniques through skill practice, which is essential to improve their ability to perform operations[7-10]. Another training model that is gaining popularity in healthcare is the flipped classroom model, in which the trainees are provided with learning resources (including paper materials, video, or audio lecture content, *etc.*) before attending the class, dedicating the classroom time for engaging and interactive discussion and experiential practices [11-16]. In workshop or teacher-focused training, trainers should stimulate learners' interest from



multiple perspectives. The training effect largely depends on nurses' interest and participation. As shown in several previous studies in the field of nursing, appropriate training methods can have a positive effect on nurses' participation in training. Several studies have explored the application of the flipped classroom model alone in nursing training. For example, Yi and Ding[17] implemented flipped classroom teaching in nursing management, and 96.8% of the students believed that it could promote learning and recognized this teaching mode. Yang *et al*[18] applied the flipped classroom model in geriatric nursing courses, and the results showed that there was no significant difference in the scores of comprehension and memory questions between groups, but the case analysis ability and autonomous learning ability were significantly improved. Liu *et al*[19] found that implementing the flipped classroom mode in nursing teaching in higher vocational colleges can improve students' autonomous learning ability, and their theoretical and operational assessment scores are significantly improved.

Previous studies have compared using workshops and flipped classroom models separately with conventional teaching methods[20-22]; however, to date, no study has examined the effectiveness of the combination of workshops and flipped classroom teaching techniques in medical education, although the concept theoretically exists in education[23]. The only literature on such an approach was a report that was published in the context of a flipped classroom workshop, during a conference[24]. It has been suggested that the flipped classroom technique engages trainees for a longer period and improves knowledge retention as well as performance of trainees, compared to more conventional teaching methods that are usually teacher-focused and theory-centered[25-27].

Our hospital set up a tube nurse specialist team in 2018. The workshop model was used to train 159 nurses who joined the hospital in 2018. After comprehensively evaluating the effectiveness of the workshop, the structure of the training model was reformed and the nurses who joined the hospital in 2019 received training based on a blended learning approach involving, a combination of the workshop with the flipped classroom model; this model was based on the hypothesis that the combination of the two methods could enhance the effectiveness of the training. Therefore, our study aimed to compare the effectiveness of workshop-only training with the combination of workshop and flipped classroom training on improving the teaching technique of tube fixation for nursing students. The findings of our study could provide new teaching methods to improve the effectiveness and safety of tube indwelling in clinical nursing.

## MATERIALS AND METHODS

### *Study design and subjects*

This was a prospective cohort study involving 149 newly graduated trainee nurses who joined the Sun Yat-Sen Memorial Hospital of Sun Yat-Sen University in 2019 and received blended training, based on the combination of the workshop and flipped classroom (experimental group), and 159 nurses who joined the hospital in 2018 and received only workshop-based training (control group). All trainees were newly graduated nurses and were in their first year of working as registered nurses; they had no previous work experience or tube-related training. Biostatistics is not covered in this manuscript.

### *Training methods*

Tube fixation training is part of the standardized training course for new nurses at Sun Yat-Sen Memorial Hospital. The student nurses are required to complete the training and assessment course of this technique before working independently, in order to safely perform the procedure as well as meet the needs of clinical nursing work.

The control group received only in-class training using the traditional workshop model, including on-site explanation, on-site demonstration, group exercises, and summary assessments. The experimental group received tube fixation training using workshops in combination with a flipped classroom approach. The workshop combined with the flipped classroom model was led by a group of tube specialists from the hospital and was designed as two modules: Pre-class teaching and in-class training (Figure 1).

### *Pre-class training content and requirements*

The pre-class training content was divided into three components.

**Training design and requirements:** Before the lecture, the training instructors designed the overall training objectives and content. The resources were then provided to the newly recruited nurses to study in advance. Furthermore, the instructors briefed the nurses on the combined approach that would be used for the tube fixation training and explained the study content and importance of pre-class training to facilitate independent learning. The training instructors regularly sent the trainees learning notices every week through a network communication platform, to encourage them to complete the pre-class self-study, following which they collected feedback.

**Design and distribution of the pre-class training content:** The training instructors sent the nurses pre-

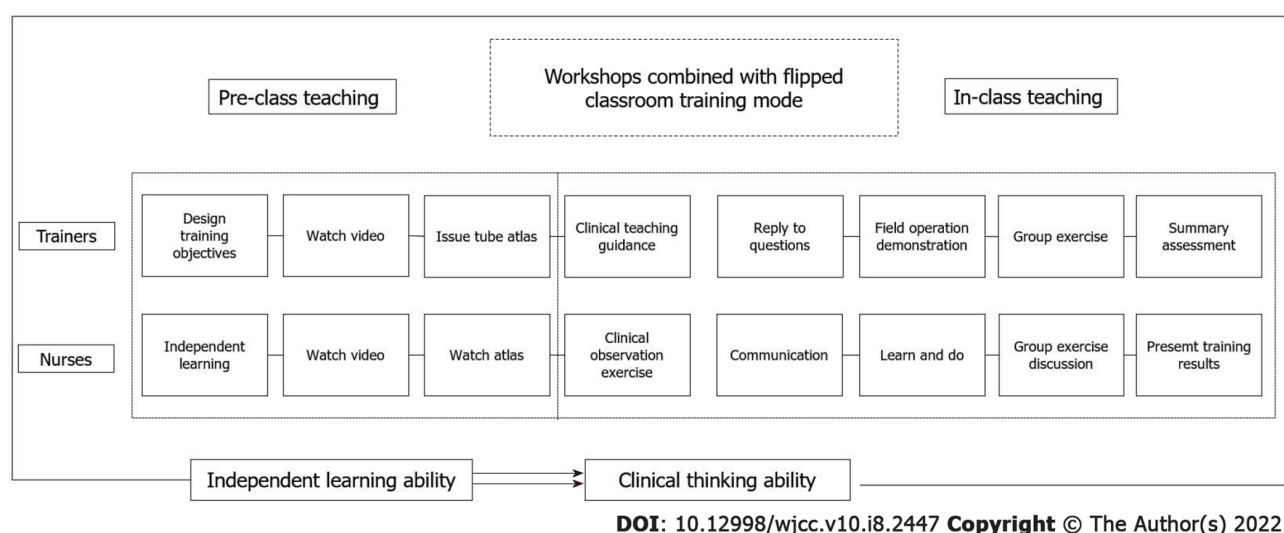


Figure 1 Tube fixation training design of the workshop combined with the flipped classroom.

class training content that included a video operation guide of tube fixation and the fixation chart. The commonly used clinical tubes are divided into two categories: venous tubes and non-venous tubes. Non-venous tube fixation methods are further subdivided into gastric tube fixation, tracheal intubation fixation, I-shaped fixation, one-shaped fixation, and knot fixation methods. There are a total of seven tube fixation methods, and seven videos were recorded by the tube specialist group, each being 3-6 min in length. The nurses were required to watch the videos and were encouraged to engage in group discussions and ask questions in class. The tube fixation guide atlas was compiled by the tube specialist group, printed in large color pages, and distributed as a reference to the new nurses.

**Observation and practice:** The chief clinical instructor who approved the training and assessment designed by the tube specialist group provided guidance to the new nurses while they observed and practiced the tube fixation technique in a clinical setting.

#### ***In-class training content and requirements***

The in-class training of the newly graduated nurses from the control and experimental groups was divided into two sessions, each session being 4 h long. After the training, each nurse was assessed for 0.5 h, totaling 4.5 h. The assessment mainly included three modules for the control group, including on-site demonstration, independent group practice and Q&A guidance, and on-the-spot examination. For the experimental group, a summary module was added.

**On-site demonstration:** The tube specialist group demonstrated the abovementioned seven fixation methods with physical projection equipment. The time to demonstrate each method was limited to 10-20 min, and the instructors simultaneously explained the methods. The key points, difficulties, and details of the methods were focused on. For the experimental group, theory and knowledge were supplemented based on actual cases.

**Independent group exercise and Q&A guidance:** The new nurses were organized in groups of 8-10. The instructors provided the trainees with tube models and exercise consumables. All nurses participated in the exercise and were encouraged to discuss the key difficulties and problems. The instructors answered any questions that the nurses had and guided each of them to practice independently.

**Summary:** The instructors answered any queries that the nurses had and summarized the advantages and disadvantages experienced during the practical application.

**On-the-spot examination:** All new nurses participating in the training had to complete the assessment by performing all seven fixation methods. The instructors worked in groups of two, and each group was responsible for the assessment and scoring of a fixation method.

#### ***Outcomes of the assessments***

The participation of the new nurses in the training activities, on-site assessment of the training, nurses' evaluation of the training, and related indicators of tube quality management were evaluated. The nurses in the control group only participated in the on-site assessment of tube fixation methods and training satisfaction surveys.

**Participation of nurses in training activities:** For pre-class training, based on the observations of the chief instructors in each ward, the understanding of the nurses when learning to use the tube fixation atlas, the methods of tube fixation, and the participation of the nurses in the actual practice of tube fixation were recorded. For in-class training, the participation of the nurses was recorded through their participation in group exercises and discussions.

**On-site assessment of the training:** The assessment was conducted immediately after completing the on-site training and independent exercises. Instructors worked in teams of two and were responsible for the assessment of a fixation method. The nurses were required to complete the assessment and scoring of all fixation methods. The methods were scored using the percentile system, with  $\geq 80$  points indicating that the methods qualified; the fixation methods were deemed qualified only if they met the standards.

**Evaluation of the training by the nurses:** After class, a self-designed questionnaire was used to understand the evaluation of the training models by the trainee nurses. The questionnaire included the evaluation of the training models and the training content. Likert's 5-level scoring scale was used to evaluate the training models. The responses were scored on a scale of 1-5, ranging from "completely disagree" to "completely agree" and "very bad" to "very good." The questionnaire was completed on-site after training.

### **Relevant indices of tube quality management**

The standard clinical tube fixation rate, UEX rate, and incidence of tube-related pressure ulcers were recorded after the training. The standard clinical tube fixation rate was calculated as the number of fixed standard tubes/total number of tubes  $\times 100\%$  [1-3]. The UEX rate refers to the proportion of UEX of catheters occurring in hospitalized patients to the total number of days of indwelling of a catheter or to the total number of cases of catheter insertion during the same study period. The incidence of pressure ulcers is equal to the number of new cases of pressure injuries in hospitalized patients in the same period/total number of hospitalized patients in the same period  $\times 100\%$ .

### **Statistical methods**

All analyses were performed using the SPSS 20.0 software (IBM, Armonk, NY, United States). Continuous variables are presented as means  $\pm$  SD and were analyzed using the Student's *t*-test. Categorical data were presented as *n* (%) and were compared using a chi-square test. Ordinal data were presented as *n* (%) and were compared using the Mann-Whitney *U*-test. *P* values of  $< 0.05$  were considered to be statistically significant.

## **RESULTS**

### **Characteristics of the nurses**

The average age of nurses in the control group was  $22.94 \pm 0.94$  years and that of those in the experimental group was  $25.42 \pm 3.23$  years ( $P < 0.01$ ). There were no significant differences in sex and educational background between the two groups (Table 1).

### **Training assessment**

The qualified rate of the after-class assessment for the experimental group was 100.00%, with an average score of  $94.01 \pm 2.78$  points, compared to a qualified rate of 91.82% for the control group, with an average score of  $84.24 \pm 2.94$  points (both  $P < 0.01$ ; Table 2).

### **Nurses' evaluation of the workshops combined with a flipped classroom**

All 149 nurses in the experimental group completed the evaluation questionnaire. Most nurses completely agreed that the training model based on the combination of workshops and a flipped classroom was beneficial for cultivating clinical thinking (59.73%, score of  $4.50 \pm 0.68$ ), encouraging independent learning ability (62.41%, score of  $4.56 \pm 0.62$ ), and mastering knowledge (66.44%, score of  $4.52 \pm 0.76$ ) (Table 3). In the experimental group, 52.35% nurses found that the pre-class training video helpful (score of  $4.28 \pm 0.89$ ), 72.48% nurses found the pre-class tube atlas helpful (score of  $4.68 \pm 0.54$ ), 59.06% nurses found the pre-class chief-instructor guidance helpful (score of  $4.51 \pm 0.65$ ), 88.59% nurses found the in-class demonstration helpful (score of  $4.87 \pm 0.37$ ), and 84.56% nurses found the in-class practice helpful (score of  $4.84 \pm 0.39$ ) (Table 4). The evaluation score of the tube fixation training was higher in the experimental group compared to that in the control group ( $4.88 \pm 0.38$  vs  $4.67 \pm 0.64$ ,  $P < 0.01$ ; Table 2).

### **Relevant indices of tube quality management**

After analysis and training, the clinical tube fixation methods were retrospectively analyzed at the end

**Table 1 Characteristics of the nurses who joined our hospital in 2018 and 2019**

Characteristics	Control group (n = 159)	Experimental group (n = 149)	P value
Age, years (mean ± SD)	22.94 ± 0.94	25.42 ± 3.23	< 0.01
Sex (male/female), n (%)	17/142 (10.69/89.31)	21/128 (14.09/85.91)	0.36
Education background, n			
Masters/Undergraduate	1/158 (0.63/99.37)	2/147 (1.34/98.66)	0.52

**Table 2 Comparison of the training assessment and satisfaction of the nurses who joined our hospital in 2018 and 2019**

Characteristics	Control group (n = 159)	Experimental group (n = 149)	P value
Assessment scoring (mean ± SD)	84.24 ± 2.94	94.01 ± 2.78	< 0.01
Evaluation scoring (mean ± SD)	4.67 ± 0.64	4.88 ± 0.38	< 0.01
Number of up-to-standard patients, n (%)	146 (91.82)	149 (100.00)	< 0.01

**Table 3 Evaluation of the workshop combined with flipped classroom training model by nurses who joined our hospital in 2019 (n = 149)**

Items	Score (mean ± SD)	Completely agree (%)	Mostly agree (%)	Basically agree (%)	Not agree (%)
Good for cultivating clinical thinking	4.50 ± 0.68	89 (59.73)	46 (30.87)	13 (8.72)	1 (0.67)
Good for cultivating independent learning ability	4.56 ± 0.62	93 (62.41)	48 (32.21)	7 (4.69)	1 (0.67)
Good for mastering knowledge	4.52 ± 0.76	99 (66.44)	32 (21.47)	15 (10.06)	3 (2.01)

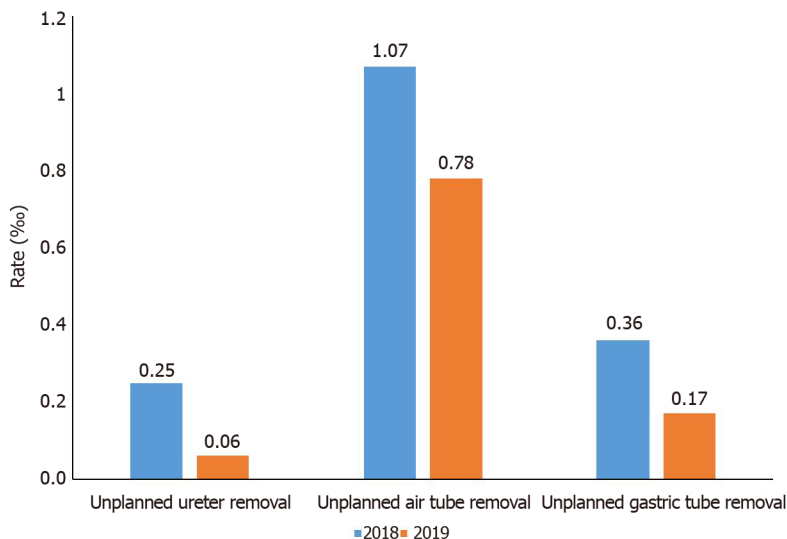
**Table 4 Evaluation of the workshop combined with flipped classroom training content by nurses who joined our hospital in 2019 (n = 149)**

Item	Score (mean ± SD)	Great (%)	Good (%)	General (%)	Bad (%)	Terrible (%)
Pre-class teaching video	4.28 ± 0.89	78 (52.35)	42 (28.19)	23 (15.44)	5 (3.36)	1 (0.67)
Pre-class tube atlas	4.68 ± 0.54	108 (72.48)	35 (23.49)	6 (4.03)	0	0
Pre-class main instructor guidance	4.51 ± 0.65	88 (59.06)	52 (34.90)	7 (4.70)	2 (1.34)	0
In-class demonstration	4.87 ± 0.37	132 (88.59)	15 (10.07)	2 (1.34)	0	0
In-class practice	4.84 ± 0.39	126 (84.56)	22 (14.77)	1 (0.67)	0	0

of 2019, and the standard fixation compliance rate was 96.03%. On comparing the rate of UEX events at our hospital in 2018 and 2019, we observed that the rate of unplanned ureteral tube removal decreased from 0.25‰ to 0.06‰, the rate of unplanned chest tube removal decreased from 1.07‰ to 0.78‰, and the rate of unplanned gastric tube removal decreased from 0.36‰ to 0.17‰ (Figure 2). Retrospective analysis of the pressure ulcers in the 2 years before and after training revealed that they mainly occurred with gastric tubes. The number of cases of pressure ulcers decreased from 33 to 22, and the incidence decreased from 0.78‰ to 0.45‰.

## DISCUSSION

In this study, we compared the effectiveness of workshop-only training and the combined training model for improving the tube fixation training of nursing students. Our results strongly demonstrate that a blended learning approach using the combination of the workshop training and the flipped classroom training models was effective in improving the quality of teaching and learning the tube fixation methods. In addition, using this model encouraged the nurses' enthusiasm and eagerness for interactive and independent learning and clinical thinking as well as improved the safety of the



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Figure 2 Comparison of the incidence of unplanned extubation in 2018 and 2019.

procedure.

The instructors should stimulate the nurses' interest from multiple perspectives in order to influence as many trainees as possible[24]. The effectiveness of the training depends, to a large extent, on the training methods along with interest and participation of the nurses, which can have a positive effect on the quality of their participation in training. Some studies showed that the workshop training model could more effectively stimulate the nurses' interest in learning compared to traditional teaching methods[28,29]. The flipped classroom model is focused on the students, and a large number of studies have shown that flipped classrooms can effectively improve the independent learning ability of students [19,25-27,30-31]. In this study, using the combination of the two learning models, the nurses were required to self-study before the class by watching videos and an atlas. Then, while in class, they were required to observe and practice the operations, find problems and solutions, and seek advice and clarifications regarding doubts from the clinical guidance teachers. The tube specialists then conducted practical ability training for all nurses through the workshop and finally completed the assessment. During the entire training process, as the main body of learning, not only did the nurses develop an interest in learning and cultivate the ability of independent learning, they also ensured the final effect of training. After completing the training course, some nurses commented the following: "this form of training is different from the inflexible classroom theoretical study. It enables us to learn on our own, has more opportunities for practical practice, engages in more exchanges and discussions, and improves our ability to think about clinical problems." This response is reflected by the high satisfaction scores of the experimental group with regard to the training course.

In addition, as a result of the high quality of training, our study shows that combining the workshop and flipped classroom training models helps in improving the safety of using tubes in clinical practice. The nurses in our study provided good evaluation scores for the content of the training model, especially its ease of use, operation demonstration, and operation practice with the guidance of the tube fixation atlas; this proved to greatly improve the enthusiasm and eagerness of the nurses during training as well as the outcomes of training. Furthermore, analysis of clinical data after training showed that the fixation rate of clinical tubes reached 96.03%, and the busy work schedules of the nurses did not hamper their understanding and the effectiveness of tube fixation. When analyzing the UEX events at our hospital 1 year before and after the training, tube UEX rates decreased and the incidence of pressure ulcers caused by tubes decreased from 0.78‰ to 0.45‰; these rates indicate a better understanding of clinical tube fixation, which ensures that the tubes do not cause harm to the patients while playing effective roles in their treatment.

Despite the improvements observed with the novel combined training model, our study has some limitations. The participants in our study were inexperienced, newly graduated nurses, and this training model should be applied to assess the continuous education of experienced nurses as well.

Although good training results have been achieved using the combined training model for tube fixation, several problems need to be addressed. First, the inadequate training conditions cannot be ignored, and access to basic training equipment must be considered[32]. Due to the lack of literature on tube fixation training, this study has a theoretical and exploratory disadvantage. Furthermore, the number of nurses are higher than the number of trainers, and training efficacy cannot be guaranteed. Second, it is necessary to understand the adaptability of the trainers and nurses to the flipped classroom approach. To smoothly apply the flipped classroom model, it is necessary to encourage the nurses to



become the main body of learning; change the traditional teacher-student relationship; and encourage nurses to find problems, raise issues, and think about problems that may be encountered during learning. Third, attention should be paid to effectively combine and promote the two training models. This study suggests that the pre-class training on tube fixation can be adequately conducted by using the flipped classroom model, but the in-class training should be conducted using the workshop model to ensure that the nurses have enough time to practice their skills. Further studies are required to refine and optimize the training content.

One limitation of this study is that the combined training model was in its first year of implementation. Similarly, the instructors responsible for designing the training were themselves exploring the course whilst conducting it. Moreover, the research scheme was immature. Due to the limitation of information technology, the pre-class contents could not be well mastered, and the pre-class training could not be effectively conducted. Furthermore, we did not record the observation of the instructors, so there was no effective evaluation of the differences in the training models by supervisors. Information from only the nurses was obtained by individually talking to them at the training site. Therefore, our study lacks robust quantitative results. The two groups in our study comprised nurses of different ages, and the training sessions were conducted at two different periods, which may have led to biases. Additional studies are necessary to address these limitations.

## CONCLUSION

In conclusion, our results prove that a combined approach using workshop along with flipped classroom training is helpful in improving tube fixation training for student nurses. This novel combined model of a workshop and flipped classroom is in line with the development of modern informatization and innovation in sciences. Using the flipped classroom approach is particularly helpful to encourage nurses to become the main body of learning by active and interactive participation. In addition, it ensures the integration of theory with practical application, so as to achieve optimum effective training.

## ARTICLE HIGHLIGHTS

### **Research background**

Nurse training for tube fixation is necessary to prevent unplanned extubation.

### **Research motivation**

No study has examined a combination of both workshop and flipped classroom models in tube fixation training for nurses.

### **Research objectives**

This study aimed to compare workshops plus flipped classroom model with workshops alone to deliver tube fixation training for nurses.

### **Research methods**

Nurses were trained according to the two models, and the quality indicators of the training were then evaluated.

### **Research results**

Nurses in the combined training group scored higher than nurses who received workshop training alone.

### **Research conclusions**

Workshop plus flipped classroom models are effective in improving tube fixation training in nurses.

### **Research perspectives**

Future studies can investigate class content, record trainers' observations, and devise an effective method to evaluate the training model.

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## FOOTNOTES

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