Exploration on the Application of Flipped Classroom in Anesthesia Training

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Abstract: We implemented a 12-week program involving 50 first-year residents who participated in pre-course learning, interactive classroom activities, and post-course reinforcement. Results showed a significant increase in self-comfort levels ($p<0.001$) and a significant increase in teachers' ratings of students' high reliability ($p<0.001$). These findings suggest that the flipped classroom model improves confidence and practical ability in anesthesiology training. The study highlights the potential of this approach to improve resident education, particularly for early learners, and calls for further research into its long-term impact on clinical performance and patient outcomes.

***Keywords*:** flipped classroom, anesthesiology training, self-comfort assessment, student reliability rating, medical education innovation

1. Introduction

The flipped classroom model[1] has emerged as a transformative approach in medical education, particularly in disciplines requiring a balance of theoretical knowledge and practical skills, such as anesthesiology. Traditional lecture-based methods often fail to engage learners effectively, leading to gaps in knowledge retention and clinical application[2]. For first-year anesthesiology residents, the transition from theoretical learning to hands-on practice can be challenging. The flipped classroom model, which shifts content delivery to pre-class activities and reserves in-class time for interactive learning, offers a promising solution. This study investigates the application of the flipped classroom model in anesthesiology residency training for first-year residents, evaluating its effectiveness through self-comfort assessments and student reliability ratings.

2. Methods

2.1 Study Design

The study involved 50 first-year anesthesiology residents enrolled in a 12-week training program. The program was divided into pre-class, in-class, and post-class phases to ensure a structured learning experience.

2.2 Intervention

2.2.1 Pre-Class Activities

Residents received curated materials—video lectures, readings, quizzes, and skill guides to build foundational knowledge. These resources prepared them for hands-on practice during interactive sessions, ensuring skill refinement and confidence in technical procedures.

2.2.2 In-Class Activities

Classroom sessions emphasized interactive learning: case discussions, simulations, and hands-on practice of key skills (e.g., intubation, central line placement, regional anesthesia) under expert guidance. This reinforced theoretical knowledge while refining practical skills in a supportive setting, building confidence and proficiency in essential procedures.

2.2.3 Post-Class Activities

Residents completed assignments and joined online forums to reinforce learning and clarify doubts. They conducted self-comfort assessments to gauge confidence in anesthesia tasks, while instructors provided reliability ratings to evaluate competence. This dual feedback system assessed both perceived comfort and actual performance, promoting continuous improvement and skill mastery.

2.3 Evaluation Methods

2.3.1 Self-Comfort Assessment

The Self-Comfort Assessment measures stress and psychological burdens in healthcare workers, aiming to prevent burnout and enhance job satisfaction. Using a 1-5 scale (1 = extreme discomfort, 5 = high comfort), it evaluates physical, mental, and emotional states after adopting the flipped c lassroom m odel, p roviding q uantitative i nsights i nto teaching effectiveness.

2.3.2 Student Reliability Rating

The Student Reliability Rating assesses resident physicians' performance in surgical marking training, evaluating skill mastery, accuracy, and learning attitude. Using a 1-5 scale (1 = completely incorrect, 5 = flawless execution), it identifies trainees' strengths and areas for improvement, providing a comprehensive measure of their capabilities.

2.4 Data Analysis

All data were analyzed using **GraphPad Prism software** (version 7.0, GraphPad Software). A one-tailed unpaired or paired t-test was used to compare the two groups (assuming normal distribution). Statistical significance was set at **$p < 0.05$**.

3. Results

3.1 Self-Comfort Assessment

The Self-Comfort Assessment results show that the flipped classroom improved resident physicians' confidence, emotional management, and stress coping abilities. Participants reported reduced anxiety and greater comfort in performing complex anesthesia procedures. Immediate feedback during experiential learning helped address shortcomings, enhancing their sense of control and comfort. Overall, the approach significantly boosted clinical skills and self-comfort, as illustrated in Figure 1.

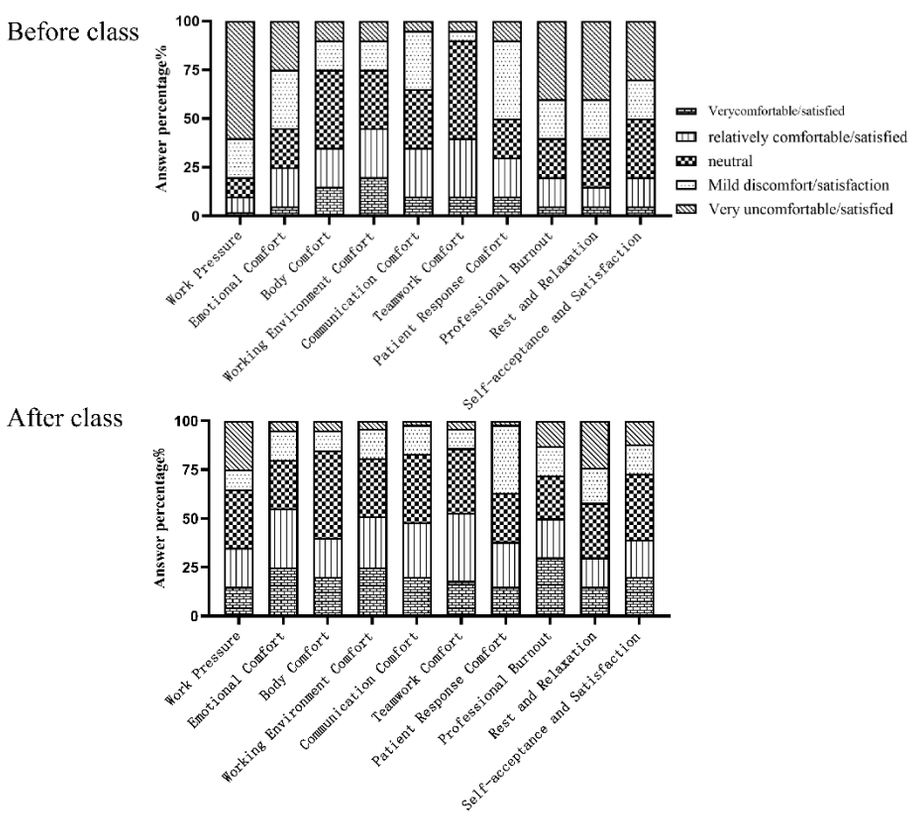

Figure 1. Self-comfort assessment before and after class

3.2 Student Reliability Rating

The Student Reliability Rating results indicate that the flipped classroom significantly improved resident physicians'

mastery of anesthesia skills and self-evaluation ($P < 0.05$). Participants reported increased confidence in clinical procedures and a better understanding of operational standards. Post-training, self-assessment scores for anesthesia skills rose, with improved accuracy and protocol adherence in practice. Physicians achieved higher reliability ratings, excelling in procedural accuracy. The flipped classroom enhanced reliability and operational confidence in anesthesia training, as shown in Table 1.

Table 1. Student credibility ratings

Evaluation Indicators	Before class	After class	t	P
Accuracy of anesthesia procedures	4±0.3412	5±0.7998	7.46	<0.0001
Operating skills mastery	3±0.1843	4±0.2976	9.07	<0.0001
Satisfaction with training	4±0.2317	5±0.7856	7.09	<0.0001
Self-confidence	3±0.8546	4±0.1256	6.87	<0.0001
Clinical situation coping skills	3±0.1297	4±0.5364	8.23	<0.0001
Time management skills	3±0.1534	4±0.2165	7.49	<0.0001
Critical thinking skills	3±0.1623	4±0.9432	9.62	<0.0001

4. Discussion

The flipped classroom model significantly benefits anesthesiology resident training by enhancing confidence, skill mastery, and operational reliability[3]. Pre-class learning and interactive sessions reduce anxiety and improve emotional management during complex procedures, as shown by Self-Comfort Assessments. Immediate feedback during hands-on practice fosters real-time skill correction, promoting control and mastery. Student Reliability Ratings confirm improved procedural accuracy and protocol adherence, bridging theory and practice.

The flipped classroom moves basics to pre-class, focusing sessions on advanced skills and discussions. It's ideal for early learners, reinforcing standards and meeting diverse needs. Limitations include small sample size and potential bias. Future research should explore long-term impacts and scalability. In conclusion, the model boosts self-comfort, skill mastery, and reliability, preparing residents for clinical practice.

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