

## Research Article

# The Application of the Online and Offline Interactive Teaching Method in Clinical Anesthesiology Teaching

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**Objective.** To explore whether better teaching effect can be achieved by applying the online and offline interactive teaching method to clinical anesthesiology teaching. **Methods.** Sixty-three students in grade three majoring in anesthesiology of Wenzhou Medical University were selected as research objects and randomly divided into 2 groups. The experimental group (32 students) adopted the online and offline interactive teaching method. The control group (31 students) adopted the traditional teaching method. The teaching effect was evaluated by the theoretical test results of the two groups and the survey of students in the experimental group. **Results.** The score of the theoretical test of students in the experimental group ( $79.31 \pm 4.54$ ) was higher than that of students in the control group ( $75.61 \pm 4.88$ ), and the difference achieved statistical significance ( $p < 0.05$ ). 81.3% of the students think that the interactive teaching method enhances the interest of learning. 90.6% (29/32) of the students in the experimental group hold positive attitude towards the fact that the overall learning effect can be improved by the online and offline interactive teaching method. **Conclusions.** The online and offline interactive teaching method can not only improve students' theoretical test results but also help to improve students' learning participation. Students have given a high score for the evaluation of the online and offline interactive teaching method; good teaching effect has been achieved.

## 1. Introduction

Clinical anesthesiology is one of the core courses of anesthesiology. It is a highly compatible modern medical discipline, which mainly covers the knowledge of adjusting life function, intensive care treatment, and pain treatment. It also integrates the knowledge of many disciplines, such as internal medicine, surgery, physiology, pharmacology, etc. [1]. Therefore, it puts forward higher requirements for professional students, requiring students to have strong learning ability and practical ability. At the same time, teachers are also required to have rich clinical knowledge and the ability to answer questions [2]. The teachers of clinical anesthesiology in our university are all served by senior doctors in affiliated hospitals. Due to the limitation of clinical working time, the course time of teachers is relatively tight, and the total number of class hours of this course is limited. In the past, the teaching method was mainly based

on teaching. This "spoon-feeding, full-house irrigation" teaching method [3, 4] ignores students' learning autonomy, flexibility, and creativity. And teachers are busy preaching knowledge in class, so it is difficult to explain a problem thoroughly, let alone expand the relevant knowledge. This arbitrary teaching method is not conducive to the mastery of students' knowledge and the improvement of related abilities.

Therefore, how to stimulate students' initiative, improve their participation before, during, and after class, and improve their ability to improve, analyze, and solve problems related to clinical anesthesiology has become a major challenge in clinical anesthesiology teaching.

In recent years, an online and offline interactive teaching method came into being under the background of the Internet, which has made attempts and breakthroughs in the combination of theory and practice, the diversification of educational subjects, the transformation of time and space of

education, dynamic teaching mode, and so on [5–7]. Generally speaking, in the traditional offline classroom teaching, the model of teacher-student relationship is relatively fixed, the dominant position of teachers is solidified because of identity, and the dominant position of students has been hidden or obviously ignored because of habits. The dialogue relationship between teachers and students lacks real equality. At present, teaching is gradually realizing the transformation from traditional teacher-led teaching mode to learner-centered autonomous learning mode. In this situation, online classes connect students, teachers, and other parties (such as parents, etc.) together through the network and can share teaching resources in the platform in real time and efficiently, such as classroom videos, micro-classes, micro-lectures, online interaction, tutoring, testing, and other tasks [8, 9]. However, online teaching needs to rely on information technology literacy and platform resource development, space differences lead to psychological barriers in teaching, time endurance, and interactive experience, and other aspects also have their inherent limitations. The establishment of online and offline interactive teaching ecology can effectively make up for the shortcomings of traditional teaching and online teaching, the new dialogue relationship between teachers and students, which is not limited by time and space, can be established, and the authority of teachers in the binary opposition mode will be dispelled [10]. Students' autonomy is enhanced, and personalized problem needs are guaranteed. In addition, in the Internet environment, teachers and students, as well as students and students, can communicate through online interaction or message prompts and other interactive functions to form a good atmosphere of communication and discussion, so that the problem can be solved in a relaxed group discussion. Students no longer passively accept the teaching content, but become the main body of the dialogue, and can actively acquire knowledge through their own activities.

Therefore, we try to apply the online and offline interactive teaching method to the classroom teaching of clinical anesthesiology, make full use of their respective advantages to arrange the teaching content, and make the two complement each other, in order to establish a flexible and practical teaching system of clinical anesthesiology under limited time and conditions, to achieve the teaching goal to the maximum extent and achieve good teaching results.

## 2. Materials and Methods

**2.1. Research Object.** Sixty-three undergraduate students majoring in anesthesiology in Wenzhou Medical University were selected as the research subjects. All the research subjects had informed consent to the study.

**2.2. Research Methods.** In this study, we adopted a randomized controlled trial method. Thirty-two students in class 1 of anesthesiology specialty were set as experimental group, and thirty-one students in class 2 of anesthesiology specialty were set as control group. There were no

interactions among the subjects in experimental group and control group. The ratio of male to female in the experimental group was 15:17, while that in the control group was 15:16, with no significant difference ( $df=1, p = 0.904$ ). The age of the students in the experimental group was  $(21.56 \pm 0.16)$  years, while the age of the students in the control group was  $(21.61 \pm 0.15)$  years, with no significant difference ( $t=0.22, p = 0.8209$ ). We compared the college entrance scores of the two groups of students, with the students in class 1  $(567.3 \pm 6.81)$  and class 2  $(563.9 \pm 7.76)$ , with no significant difference ( $t=0.13, p = 0.897$ ) (Table 1). We also compared the theoretical examination results of internal medicine courses of the two groups of students. The scores of class 1 students were  $(69.81 \pm 7.01)$  and class 2 were  $(71.48 \pm 7.20)$ , with no significant difference ( $t=0.934, p = 0.354$ ) (Table 2). Finally, we also compared the theoretical examination results of surgery courses of the two groups of students. The scores of class 1 students were  $(80.78 \pm 7.52)$  and class 2 students were  $(81.68 \pm 7.42)$ , with no significant difference ( $t=0.476, p = 0.603$ ) (Table 3). So, we think the two groups of students are comparable.

**2.3. Implementation of Teaching.** The recording process of clinical anesthesiology online course is as follows: ① The Department of Anesthesiology of our school organized all teachers to discuss and select 78 knowledge points for online teaching from 39 chapters of clinical anesthesia course. ② The director of the Department of Anesthesiology organized all teachers to arrange and shoot online courses. Each knowledge point was filmed with one video, each video lasting 15 minutes. All videos were filmed with the assistance of “wisdom tree online education platform.” The shooting of online courses encourages the participation of young teachers and arranges experienced backbone teachers to give guidance to young teachers in teaching methods, teaching skills, etc. ③ After the shooting of all knowledge points is completed, the director of the Department of Anesthesiology organizes all teachers to organically combine online knowledge points and offline content through collective lesson preparation, forming 26 complete teaching units of “teaching knowledge points offline-watching video materials online-answering questions offline.” ④ The Department of Anesthesiology and the academic affairs office jointly set up an online course website and reasonably arranged the courses of “1 class hour for offline knowledge point teaching + 1 class hour for online video learning + 1 class hour for offline question answering and puzzle solving” according to the teaching units to jointly promote the implementation of the mixed teaching method. Both groups of students used the fourth edition of the textbook “Clinical Anesthesiology,” edited by Guo Qulian and Yao Shanglong. The teaching hours were 78, and the teachers who teach all the courses in the control group are exactly the same as those in the experimental group.

**2.3.1. Implementation of Experimental Group Teaching.** The students in the experimental group adopt the mixed teaching methods. ① *Offline Teaching.* It is divided into two

TABLE 1: Comparison of college entrance results between the two classes of students.

Group	<i>n</i>	Score
Class 1	31	567.3 ± 6.81
Class 2	32	563.9 ± 7.76
<i>t</i> value	—	0.13
<i>p</i> value	—	0.897

TABLE 2: Comparison of the theoretical examination results of internal medicine courses between the two classes of students.

Group	<i>n</i>	Score
Class 1	31	69.81 ± 7.01
Class 2	32	71.48 ± 7.20
<i>t</i> value	—	0.934
<i>p</i> value	—	0.354

TABLE 3: Comparison of the theoretical examination results of surgery courses between two classes of students.

Group	<i>n</i>	Score
Class 1	31	80.78 ± 7.52
Class 2	32	81.68 ± 7.42
<i>t</i> value	—	0.476
<i>p</i> value	—	0.603

parts. The first part is the offline knowledge point teaching part. According to the curriculum arrangement, teachers will explain the theoretical knowledge involved in this course in detail through the traditional centralized teaching method and strive to make every knowledge point clear. The second part is a question-answering part. The instructor will arrange an offline question-answering course after the online course for each teaching unit is completed. The course consists of two parts: answering questions and sorting out knowledge points. The method of group discussion (four students form a group) is adopted. Students can consult teachers or discuss with classmates about knowledge points that they do not understand, so as to truly convert book knowledge into their own knowledge reserves. The number of offline teaching hours is 52 hours, and the knowledge point teaching course and the question answering course each account for 1 hour. Therefore, the offline course for each teaching unit is 2 hours, with a total of 26 classes. Considering the time arrangement of teachers, offline teaching arranges the knowledge point teaching part and the question answering part in a 2-hour course: the first hour is the teaching of new knowledge points, and the second hour is the question answering part of the previous knowledge point after the students have seen online video materials. ② *Online Teaching*. The academic affairs office of school has arranged a unified time for students to watch the video materials, which are videos of case knowledge and anesthesia skills related to theoretical knowledge points, thus strengthening the theoretical knowledge learned. Online teaching does not require the on-site participation of teacher, but only the supervision of counselors. Students can discuss in groups during the

watching process. Students can also watch online video resources repeatedly on the online course platform after class. There are 26 hours of online teaching, 1 hour at a time, and 26 classes in total.

**2.3.2. Control Group Teaching Implementation.** The students in the control group adopted the traditional teaching method; that is, the teachers prepared the teaching contents according to the teaching syllabus and gave detailed lectures on theoretical knowledge, relevant case knowledge, and anesthesia skills. The control group had 78 hours of teaching, 3 hours for each course, and 26 classes in total. In order to ensure the students' mastery of knowledge points, the last hour of each course is the time for answering questions. The students also take the form of group discussion (grouping method is the same as the experimental group), or they can directly consult teachers about their doubts.

#### 2.4. Evaluation of Teaching Effect

**2.4.1. Theoretical Examination.** After the course is over, the two groups of students will take a written examination of the same examination paper at the same time. The examination paper will be compiled by all teachers of clinical anesthesiology course and finally approved by the director of the Department of Anesthesiology. The examination time is 90 minutes.

**2.4.2. Questionnaire Survey.** Considering that the two groups of students received traditional teaching methods in the previous course study, in this study, the experimental group of students accepted the mixed teaching methods, so we chose to conduct a questionnaire survey on the experimental group of students to understand their evaluation of the mixed teaching methods compared with traditional teaching methods.

We compiled a questionnaire based on literature reading and expert consultation. The questionnaire involves students' understanding of teaching content, cultivation of autonomous learning ability, cultivation of clinical thinking ability, activity degree of classroom atmosphere, and whether they like this teaching method, etc. There are 12 scoring questions.

In order to ensure the reliability of the questionnaire, in June 2018, the members of our research group used convenient sampling method to conduct a preliminary survey on 15 students. The Cronbach coefficient of the tested questionnaire is 0.921, which is reliable. The formal questionnaire survey was completed by the students organized by the members of our research group in October 2018 after the "Clinical Anesthesiology" course was completed. The questionnaire was distributed on the spot and collected on the spot in an anonymous way.

**2.5. Statistical Analysis.** The measurement data represent the mean ± SD. There were no missing, lost, or excluded data. All data in this study were continuous data; first of all, carry on

the normality test; if each group satisfies the normal distribution, and the variance between the two groups is equal, use *t* test to compare between groups. The counting data are expressed by frequency and percentage (*n* (%)), and significance was determined at the *p* < 0.05 level. Statistical analyses were performed using Prism 6.0 software (GraphPad Software, San Diego, CA).

### 3. Results

**3.1. Theoretical Examination Results of the Two Groups.** The theoretical examination results of the experimental group students ( $(79.31 \pm 4.54)$ ) were higher than those of the control group students ( $(75.61 \pm 4.88)$ ), and the difference was statistically significant ( $t = 3.118$ ,  $p = 0.002$ ) (Table 4).

**3.2. Results of the Questionnaire Survey.** 32 questionnaires were distributed to the students in the experimental group and 32 valid questionnaires were recovered. The recovery rate of valid questionnaires was 100%. The survey results show that the students have a high degree of approval of the mixed teaching method, which is better than the traditional teaching method. The specific results are shown in Table 5.

### 4. Discussion

The specialty of anesthesiology has remarkable characteristics, strong practicability, and high employment rate, which has always been a key specialty in our university. Students majoring in anesthesiology not only need to master the basic theoretical knowledge and skills of basic medicine, clinical medicine, and anesthesiology, but also need to master the basic operations of anesthesia, first aid, and cardiopulmonary resuscitation. How to train qualified anesthesiology professionals has always been a problem for us to think about. "Clinical Anesthesiology" covers the theoretical basis of clinical medicine and skilled routine clinical operation skills, which is a combination of basic courses and clinical courses of anesthesiology, and plays an important role as a bridge [10].

The teaching system should fully consider the learning needs of students, help students improve their knowledge level, achieve learning effect, and obtain a pleasant and effective learning experience. In the last decade, the continuous progress of information and communication technology has had a far-reaching impact on human daily life, involving economic, social, medical, educational, and other fields, especially in the field of education. Schools, universities, and educational organizations of lifelong learning tend to use technological progress to promote the teaching process and improve learning outcomes [11]. These technological advances include the development of web-based educational methods and forms of education that use personal computers and mobile devices as learning tools. The online and offline mixed teaching method came into being under this background [12, 13].

In the case of limited class hours and teachers, we try the online and offline interactive teaching method, make full use of network teaching resources, effectively break the shackles

TABLE 4: Comparison of the theoretical examination results of clinical anesthesiology between experimental group and control group.

Group	<i>n</i>	Score
Control group	31	$79.31 \pm 4.54$
Experimental group	32	$75.61 \pm 4.88$
<i>t</i> value	—	3.118
<i>p</i> value	—	0.002

of traditional teaching, and greatly extend the time and space of the classroom. The curriculum system is shown in an omni-directional, multi-level, and three-dimensional way by the combination of both inside and outside the school, online and offline. Compared with the previous teaching model, the students' participation and autonomy have been stimulated to establish a flexible and practical teaching system of clinical anesthesiology, and some results have been achieved.

**4.1. Online and Offline Mixed Teaching Method Improves Students' Theoretical Examination Results.** The results of this study show that the theoretical examination results of the students in the experimental group are higher than those in the control group. Compared with the traditional teaching method, 87.5% of the students in the experimental group think that the mixed teaching method is more conducive to mastering the teaching content. The reason is that we organically combine offline teaching with various forms of online teaching, which greatly extends the time and space of the classroom.

The course teaching of the students in the experimental group is divided into online teaching and offline teaching. The traditional teaching method adopted by teachers in offline teaching can fully explain important theoretical knowledge points, and students also have time to digest and absorb them in class. The video resources for online teaching are all specific knowledge points, including case analysis, operation demonstration, anesthesia equipment, physical display of drugs, and their operation, etc. Students can watch them repeatedly [14]. The video includes interactive links such as questions and answers on the playing screen set by the teachers, which not only ensures the effect of students' video learning, but also inspires students' thinking. At the same time, the content of video resources is rich and varied, which effectively alleviates the aesthetic fatigue caused by a single teaching method and enhances students' interest in learning. It is precisely because of the organic combination of online teaching and offline teaching that the experimental group students have a more solid grasp of theoretical knowledge of clinical anesthesiology and their theoretical examination results are improved.

**4.2. Online and Offline Mixed Teaching Method Is More Beneficial to Improve Students' Participation in Learning.** Some studies have found that providing personalized and adaptive digital education is more conducive to the creation of a student-centered learning environment and can increase

TABLE 5: Evaluation of the mixed teaching methods for clinical anesthesiology courses by 32 students in 2013 grade anesthesiology experimental group of Wenzhou Medical University (N (%)).

Issue	Better than traditional teaching	Equivalent to traditional teaching	Worse than traditional teaching
Mastering the teaching content	28 (87.5%)	3 (9.4%)	1 (3.1%)
Understanding and memorizing knowledge	25 (78.1%)	7 (21.9%)	0 (0)
Ability to solve problems	23 (71.9%)	9 (28.1%)	0 (0)
Broadening the knowledge	26 (81.2%)	5 (15.7%)	1 (3.1%)
Cultivating the ability of autonomous learning	24 (75.0%)	8 (25.0%)	0 (0)
Improving language expression ability	23 (71.9%)	9 (28.1%)	0 (0)
Cultivating good clinical thinking ability	25 (78.1%)	7 (21.9%)	0 (0)
Strengthening the communication and cooperation between teachers and students and enlivening the atmosphere	24 (75.0%)	7 (21.9%)	1 (3.1%)
Enhancing the interest of learning	26 (81.2%)	6 (18.8%)	0 (0)
Accepting mixed teaching methods	28 (87.5%)	4 (12.5%)	0 (0)
Becoming familiar with and entering the role of doctor as soon as possible	23 (71.9%)	8 (25.0%)	1 (3.1%)
Improving the overall learning effect	29 (90.6%)	3 (9.4%)	0 (0)

students' participation in learning [15]. Our research also confirms this. The results of this study show that, compared with the traditional teaching method, 75% of the students in the experimental group think that the mixed teaching method can better enhance the communication between teachers and students and enliven the classroom atmosphere. 81.3% of the students think that the mixed teaching method enhances the interest of learning. 71.9% of the students think that the mixed teaching method can also improve the ability of language expression. These benefits are due to the fact that we arrange question-and-answer courses after the end of the knowledge points teaching course of each teaching unit and the network video watching course, and the teaching form is carried out in the form of group discussion. Group learning is a way of students' cooperative learning. It can not only revise and improve each student's knowledge in the process of discussion, but also effectively arouse students' enthusiasm for learning [15]. And in the process of answering questions, teachers adopt the teaching method of simulating clinical scene, allowing students to play the roles of doctor and patient, respectively. In this process, doctors participate in doctor-patient communication, weigh the pros and cons, and choose the best treatment and anesthetic methods. Not only does this enable students to bring in scene learning to deepen understanding and increase interest in learning, but also situational teaching can better cultivate students' clinical thinking, as well as the ability to analyze and solve problems, which is difficult to do in traditional teaching [16].

**4.3. The Mixed Teaching Method Has Higher Teaching Satisfaction.** The results of this study show that, compared with the traditional teaching method, 87.5% of the students in the experimental group think that the mixed teaching method is better than the traditional teaching method. Because the mixed teaching method breaks the traditional classroom teaching method, the teaching method of "rote memorization" is adopted in the classroom, and the method of "teaching knowledge points-strengthening key and difficult points-

combing knowledge points" is more beneficial for students to master what they have learned [17, 18]. The mixed teaching method, whether it is a video watching course or a question-answering course, has left students with sufficient time to consult materials and discuss freely. It can give full play to students' learning autonomy and creativity, which not only is conducive to the interactive learning between students, but also strengthens the communication between students and teachers, thus obtaining higher satisfaction from students. The online and offline mixed teaching method is produced under the background of the Internet. This method is the innovation and optimization of traditional teaching methods, which can ease the tense classroom atmosphere, create a lively classroom teaching environment, and guide the combination of students' theory and reality making the knowledge look richer, fuller, and more textured.

To sum up, in the teaching of clinical anesthesiology, compared with traditional teaching methods, mixed teaching not only improves students' theoretical examination scores, but also increases students' participation in learning, and has higher teaching satisfaction. However, the pre-recording of web-based courses requires a lot of human, material, and financial resources and requires all teachers to prepare lessons and discuss collectively in order to ensure the teaching quality of online video resources. At the end of the study, we provided all the online video materials of the mixed teaching method to the students in the control group and arranged for a teacher to answer questions by e-mail. This study lacks a follow-up study on the clinical working ability of students in the experimental group after entering the workplace. In the future study, we will follow up and collect the students in the experimental group and the control group. The evaluation data of clinical working ability can further improve the teaching reform of clinical anesthesiology and provide reference for other related courses.

## Data Availability

Some or all data, models, and code generated or used during the study are available from the corresponding author upon request (Hongxia Mei: 20655776@qq.com).

## Conflicts of Interest

The authors declare no conflicts of interest in this work.

## Authors' Contributions

Qian Wang performed the experiments and Congcong Huang collected the raw data. Xiudan Hu performed the statistical analysis and Hongxia Mei drafted the manuscript. All authors contributed towards data analysis, drafting, and critically revising the paper and agree to be accountable for all aspects of the work.

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## References

- [1] S. E. Curry, "Teaching medical students clinical anesthesia," *Anesthesia & Analgesia*, vol. 126, no. 5, pp. 1687–1694, 2018.
- [2] D. Ramsingh, B. Alexander, K. Le, W. Williams, C. Canales, and M. Cannesson, "Comparison of the didactic lecture with the simulation/model approach for the teaching of a novel perioperative ultrasound curriculum to anesthesiology residents," *Journal of Clinical Anesthesia*, vol. 26, no. 6, pp. 443–454, 2014.
- [3] D. D. Yeh and Y. S. Park, "Improving learning efficiency of factual knowledge in medical education," *Journal of Surgical Education*, vol. 72, no. 5, pp. 882–889, 2015.
- [4] S. L. K. McDonough, E. L. Alford, S. W. Finks, R. B. Parker, M. A. Chisholm-Burns, and S. J. Phelps, "Student pharmacists' perceptions of a composite examination in their first professional year," *American Journal of Pharmaceutical Education*, vol. 80, no. 1, p. 4, 2016.
- [5] L. Pei and H. Wu, "Does online learning work better than offline learning in undergraduate medical education? A systematic review and meta-analysis," *Medical Education Online*, vol. 24, no. 1, pp. 1–13, 2019.
- [6] R. Robinson, "Delivering a medical school elective with massive open online course (MOOC) technology," *PeerJ*, vol. 4, p. e2343, 2016.
- [7] B. J. Swinnerton, N. P. Morris, S. Hotchkiss, and J. D. Pickering, "The integration of an anatomy massive open online course (MOOC) into a medical anatomy curriculum," *Anatomical Sciences Education*, vol. 10, no. 1, pp. 53–67, 2017.
- [8] S. R. Mehrpour, M. Aghamirsalim, S. M. K. Motamedi, F. A. Larijani, and R. Sorbi, "A supplemental video teaching tool enhances splinting skills," *Clinical Orthopaedics & Related Research*, vol. 471, no. 2, pp. 649–654, 2013.
- [9] A. F. Hamour, A. I. Mendez, J. R. Harris, V. L. Biron, H. Seikaly, and D. W. J. Côté, "A high-definition video teaching module for thyroidectomy surgery," *Journal of Surgical Education*, vol. 75, no. 2, pp. 481–488, 2018.
- [10] T. Shiozawa, B. Butz, S. Herlan, A. Kramer, and B. Hirt, "Interactive anatomical and surgical live stream lectures improve students' academic performance in applied clinical anatomy," *Anatomical Sciences Education*, vol. 10, no. 1, pp. 46–52, 2017.
- [11] C. Troussas, A. Krouskas, and M. Virvou, "Social interaction through a mobile instant messaging application using geographic location for blended collaborative learning," in *Proceedings of the 2017 8th International Conference on Information, Intelligence, Systems & Applications (IISA)*, pp. 1–5, Larnaca, Cyprus, August 2017.
- [12] C. Troussas, A. Krouskas, and M. Virvou, "Adaptive e-learning interactions using dynamic clustering of learners' characteristics," in *Proceedings of the 2019 10th International Conference on Information, Intelligence, Systems and Applications (IISA)*, pp. 1–7, Patras, Greece, July 2019.
- [13] A. Krouskas, C. Troussas, and M. Virvou, "SN-Learning: an exploratory study beyond e-learning and evaluation of its applications using EV-SNL framework," *Journal of Computer Assisted Learning*, vol. 35, no. 2, pp. 168–177, 2019.
- [14] C. J. Daly, J. M. Bulloch, M. Ma, and D. Aidulis, "A comparison of animated versus static images in an instructional multimedia presentation," *Advances in Physiology Education*, vol. 40, no. 2, pp. 201–205, 2016.
- [15] L. C. Hodges, "Contemporary issues in group learning in undergraduate science classrooms: a perspective from student engagement," *CBE-Life Sciences Education*, vol. 17, no. 2, p. es3, 2018.
- [16] A. Gregory, G. Hogg, and J. Ker, "Innovative teaching in situational awareness," *The Clinical Teacher*, vol. 12, no. 5, pp. 331–335, 2015.
- [17] J. N. Cousins, K. F. Wong, B. L. Raghunath, C. Look, and M. W. L. Chee, "The long-term memory benefits of a daytime nap compared with cramming," *Sleep*, vol. 42, no. 1, pp. 1–7, 2019.
- [18] J. G. Y. Luc, E. D. Verrier, and M. S. Allen, "Does cramming work? impact of national web-based thoracic surgery curriculum login frequency on thoracic surgery in-training exam performance," *The Journal of Thoracic and Cardiovascular Surgery*, vol. 156, no. 2, pp. 922–927, 2018.