



# A single-center, cross-sectional study of cross-professional faculties' perception to virtual class under different scenarios: A stepwise approach

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## Abstract

**Background:** Virtual teaching in medical education is rising with the increased need caused by the recent pandemic. However, evaluations of the perception of clinical teachers across professions for setting a virtual class in different teaching scenarios are limited. This study aims to identify cross-professional clinical teachers' perception of virtual classes and the acceptability of the virtual class-specific checklist for setting a virtual class.

**Methods:** We conducted a cross-sectional study to investigate clinical teachers' need to set and teach a virtual class and then designed a virtual class-specific checklist with five essential steps and a related training program in July 2021. After the training, 186 participants were randomly enrolled in October 2021 to evaluate their perceptions about setting virtual classes and the acceptability of the virtual class-specific checklist using an online assessment questionnaire.

**Results:** In our institution, the number of faculty-led virtual classes has recently been on the increase. Our study revealed that most teachers agreed that virtual classes could break space and time limitations, but that the Internet environment could affect the fluency of the virtual class. They further agreed that the essential five steps in the checklist should vary depending on the type of teaching scenario. Most clinical teachers, with the exception of those who teach in the operating room, considered the operating room as the most difficult scenario for setting virtual classes.

**Conclusion:** Faculty training for setting virtual classes is essential, and the essential virtual class-specific five steps are suitable for different teachers and teaching scenarios. However, the virtual class-specific checklist should be further adjusted according to the limitations caused by emerging innovative virtual teaching technology.

**Keywords:** Clinical teachers; Faculty training; Teaching scenario; Virtual classes

## 1. INTRODUCTION

In recent years, there has been a shift in medical education from the conventional to virtual style of teaching.<sup>1</sup> However, it has also been recognized that teachers are under extra pressure under a paradigm shift in medical education.<sup>2</sup> A previous study revealed that although clinical teachers require more time and work to teach virtually, they become more efficient once they are familiar with a virtual teaching setting.<sup>3</sup> The advantages of

virtual classes include accessibility and unlimited flexibility of teaching/learning resources.<sup>4</sup> Virtual teaching allows students to learn in a preferred environment at their convenience, and provides access to specialized experts regardless of geographic/time restrictions and cost.<sup>5-7</sup> In this era of advanced technology, although not easy, virtual clinical teaching is inevitable for future physicians.<sup>8,9</sup>

It has been reported that several key barriers, including lack of time, skills, infrastructure, institutional strategies and support, and collaboration between faculty, need to be considered when developing and implementing virtual teaching.<sup>10</sup> Many teachers felt unprepared when facing the sudden shift toward virtual teaching on a large scale.<sup>11</sup> As virtual teaching becomes the primary way of medical education, there will be an increasingly urgent need for faculty training.<sup>11</sup> Future physicians face a progressively complex medical environment with an emphasis on a digitalized healthcare system.<sup>12</sup> This paradigm shift in medical practice is associated with a growing need for teamwork, and junior medical personnel training will rely on cross-profession collaboration to solve patients' problems.<sup>13</sup> In terms of the involvement of multiple professions' faculty and students, the virtual style is especially convenient.<sup>14,15</sup> In particular, during the transition from conventional to virtual settings, skills

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for setting a virtual class should be taught according to different scenarios, including outpatient clinics, surgical rooms, and at bedside.<sup>8,16</sup>

With the COVID-19 pandemic and advances in information technology, virtual teaching has become a trend in Taiwan's educational medical system.<sup>17,18</sup> However, some clinical teachers are still unfamiliar with electronic equipment for virtual teaching such as microphones and cameras.<sup>18</sup> They have also expressed concern about Internet instability.<sup>18</sup> Hence, faculty development programs are required to improve the skills of clinical teachers for the setting of virtual classes.<sup>10,19</sup>

In Taiwan, during training courses, resident physicians, including those under postgraduate programs or in residency with specialties, usually rotate between the medical center and community hospital. In comparison with the community hospital, the medical resources, including expert-led clinical practice, research, education, and teaching, are abundant in the medical center.<sup>20,21</sup> With the COVID-19 pandemic, there have been challenges to residency training programs in several specialties due to decreased clinical and surgical activities.<sup>22</sup> Telemedicine technology facilitates doctors' training as it affords them access to virtual courses during rotation in the community hospital regardless of space and time limitations.<sup>9,23</sup> From an annual survey, we found a growing need for faculty training for virtual classes based on different teaching scenarios in our institution. Accordingly, this study aims to identify cross-professional clinical teachers' perceptions about the advantages and disadvantages of the setting of virtual classes in our institution, as well as the influence and acceptability of the virtual class-specific checklist and workshop for establishing their skills in creating a virtual class setting.

## 2. METHODS

### 2.1. Settings and data

Taipei Veterans General Hospital is a medical center and teaching hospital in Taiwan. For faculty training, the division of faculty development was established under the department of medical education. After a field study to investigate clinical teachers' requirements for setting a virtual class, our team designed a virtual class-specific checklist, workshop, and assessment questionnaire for clinical teachers in 2021. The virtual class-specific checklist included five essential steps for setting a virtual class (Table 1).

Through lectures, demonstration, role-playing, and discussion, experienced teachers were invited to share the experience of applying the essential five steps skills of setting virtual classes in 3 hours workshop held in July 2021. The entire workshop was recorded into a video clip and uploaded to the online course platform of our institution. A questionnaire was given to the clinical teachers after workshop to evaluate their acceptability of the virtual class-specific checklist and perceptions regarding the advantages and disadvantages of the virtual classes.

In our teaching assessment e-platform, classes are divided into either virtual or conventional. In addition to gender, the professions of clinical teachers were divided into medicine, nursing, and others. Other clinical teachers include pharmacology, physiotherapy, speech therapy, nutriology, radiology, and laboratory medicine. The medical faculty could be further divided into those who mainly teach in the operating room, including specialties of neurosurgery, orthopedics, cardiovascular surgery, chest surgery, gynecology, ophthalmology, and anesthesiology, as well as those who do not teach in the operating room, including internal medicine, pediatrics, dermatology, neurology, interventional radiology, pathology, and emergency medicine.

The clinical teachers' perception about the most difficult teaching scenario (Statement 6 of the questionnaire in Table 2) were further compared between medical faculty and clinical teachers of non-medicine, as well as medical faculty who mainly teach in the operating room versus those who do not teach in the operating room. All above mentioned data were compared among different professions or gender.

### 2.2. Participants

A total of 186 clinical teachers of different professions were randomly enrolled in this study, and they were voluntary to join the virtual workshop, watch the online course, or fill out an assessment questionnaire after the training.

### 2.3. The essential five steps in the virtual class-specific checklist

Numerous strategies and tips have been discussed in previous studies to address challenges when delivering effective virtual teaching, and most strategies focus on two aspects: the environment and interactions between the teacher and students.<sup>24-29</sup> The essential five steps in the virtual class-specific checklist from our institution were designed accordingly, and further extended to five concise components (Table 1). Before starting a virtual class, teachers need to ensure the environmental settings had been checked, which is step 1. During a virtual class, creating an encouraging atmosphere and listening to the students will benefit the interactions between the teacher and students, which are step 2 and step 3. Manner helps the teacher to get acquainted with students, which is step 4. Finally, before the end of a virtual class, the teacher can give feedback and evaluation to students, which is step 5.

### 2.4. Teaching assessment course platform

Our teaching assessment course platform is a user-friendly system that can be freely accessed and make it easy for cross-professions teachers to set up and teach in the virtual class. Additionally, the system can automatically announce the upcoming class and record the classes-related data such as users' responses to the assessment questionnaire. All classes can be categorized as virtual or conventional styles and by different teaching scenarios.

**Table 1**

#### Essential five steps in the virtual class-specific checklist for setting a virtual class

Before a virtual class
1. Environmental settings (before): Adequate lighting, maintain stable Internet connection, the teacher's head is adequately in the mid position of the screen, minimize background noise, can troubleshoot the unexpected condition of the Internet environment
During the process of a virtual class
2. Creating an encouraging atmosphere (process): Shortening the content with an adequate pause, enhancement of the interaction between the teacher and the learner, keep smiling, using the body language properly
3. Listening (process): Interaction with each learner, make sure all learners are engaged, eye contact and respond accordingly, observe the learner's body language
4. Manner for teacher-learner interaction (process): Be familiar with the learner, greeting with the learner, mutual introduction of the teacher and learner, explain the learning goals
Before the end of a virtual class
5. Feedback and evaluation (before the end): encourage learners to raise a question, give positive feedback, try to obtain the feedback from each learner, make sure learning goals are achieved

**Table 2****Assessment questionnaire**

- Do you have previous experience of training for setting a virtual class?
  - Yes
  - No
- Do you agree that the essential steps for setting a virtual class should be different by teaching scenarios?
  - Agree
  - Disagree
- What advantages does the virtual class provide? (Can choose more than one answer)
  - (A) Break space and time limitations
  - (B) Continue distant teaching in difficult situations
  - (C) Motivate relatively quiet students to actively express themselves online
  - (D) Help teacher to encourage students to speak about their ideas
  - (E) Convenient for the students to precisely express their ideas with words and sentences
- What disadvantages does the virtual class provide? (Can choose more than one answer)
  - (A) The Internet environment would affect the fluency of the virtual class
  - (B) Teacher needs to have enough equipment for website teaching in a virtual class
  - (C) A virtual class is not suitable for formal examinations, such as OSCE
  - (D) Lack of body language interaction found in conventional conditions
  - (E) Virtual classes have the risk of unsafe information
- What step of the essential five steps in the virtual class-specific checklist do you agree for setting a virtual class? (Can choose more than one answer)
  - (A) Environmental settings (before)
  - (B) Creating an encouraging atmosphere (process)
  - (C) Listening (process)
  - (D) Manner for teacher–learner interaction (process)
  - (E) Feedback and evaluation (before the end)
- What is the most difficult teaching scenarios for applying the essential five steps in the virtual class-specific checklist for setting a virtual class?
  - (A) Operating room
  - (B) Bedside teaching
  - (C) Teaching clinics
  - (D) Small group teaching

**2.5. Assessment questionnaire**

Among voluntary teachers, the assessment questionnaire contained six statements to evaluate the acceptability of the virtual class-specific checklist and perceptions regarding virtual classes, including the advantages and disadvantages (Table 2). Four experts were involved in the evaluation of the content validity of this questionnaire. The questionnaire was given to cross-professions clinical teachers through the online course platform after the training in October 2021.

**2.6. Statistical analysis**

Cochran-Armitage trend test was used to assess the linear trend in proportions of different classes. For all clinical teachers, their degree of agreement with statements regarding advantages, disadvantages, and essential five steps of the virtual class were analyzed by one-way ANOVA test and Tukey's Honestly Significant Difference for post hoc test. Chi-square test and Fisher's exact test with Bonferroni correction for multiple comparisons were used to evaluate the difference of the degree of agreement to certain statement from different professions. Also, Chi-square test and Fisher's exact test were used to evaluate the difference of the degree of agreement to certain statement from different gender. The percentage of clinical teachers with previous experience of training for setting a virtual class and their degree of agreement with the statement "The essential steps for setting a virtual class should be different by teaching scenarios" were analyzed

by Chi-square and Fisher's exact test. Statistical significance was considered when  $p$ -value  $< 0.05$ . Data were analyzed by SAS software (version 9.4, SAS Institute Inc., Cary, NC).

**3. RESULTS****3.1. Basal characteristics of participants**

The participants consisted of 38 clinical teachers in medicine, 108 in nursing, and 40 in other professions (Table 3). Regarding gender, there were 40 male clinical teachers and 146 female clinical teachers (Table 3). The percentage of clinical teachers with previous experience of training for setting a virtual class neither differed between medicine, nursing, and other professions nor between the male and female teachers (Table 4).

**3.2. The number of virtual classes for faculty training courses increased from 2018 to 2021**

There was a significant upward trend in the percentage of virtual faculty training courses (Table 5). Meanwhile, conventional faculty training courses showed a proportionate decrease (Table 5).

**Table 3****Basal characteristics of cross-professional clinical teachers**

Discipline	Number of clinical teachers (%)	Gender	
		Female	Male
Medicine	38 (20.4%)	12	26
Nursing	108 (58.1%)	107	1
Others	40 (21.5%)	27	13
Overall	186	146 (78.5%)	40 (21.5%)

**Table 4****Distribution of clinical teachers with previous experience of training for setting a virtual class**

Variables	Number of clinical teachers	With previous experience of training for setting a virtual class		$p^a$
		Yes (%)	No (%)	
Discipline				0.5762
Medicine	38	19 (50.0%)	19 (50.0%)	
Nursing	108	53 (49.1%)	55 (50.9%)	
Others	40	16 (40.0%)	24 (60.0%)	
Gender				0.4582
Male	40	21 (52.5%)	19 (47.5%)	
Female	146	67 (45.9%)	79 (54.1%)	

<sup>a</sup>Comparisons of categorical variables were analyzed using chi-square test or fisher's exact test as appropriate.

**Table 5****The changing trends of faculty training courses from 2018 to 2021**

Type of classes, no. (%)	Years				$p^a$
	2018	2019	2020	2021	
Virtual classes	126 (0.73)	140 (0.79)	182 (1.06)	601 (3.56)	$< 0.001$
Total number of classes	17,193	17,814	17,152	16,896	
Conventional classes	17,067 (99.27)	17,674 (99.21)	16,970 (98.94)	16,295 (96.44)	$< 0.001$
Total number of classes	17,193	17,814	17,152	16,896	

<sup>a</sup>Results were considered statistical significant by  $p < 0.05$ , and examined by the Cochran-Armitage trend test.

### 3.3. Most of the clinical teachers agreed that virtual classes can break space and time limitations

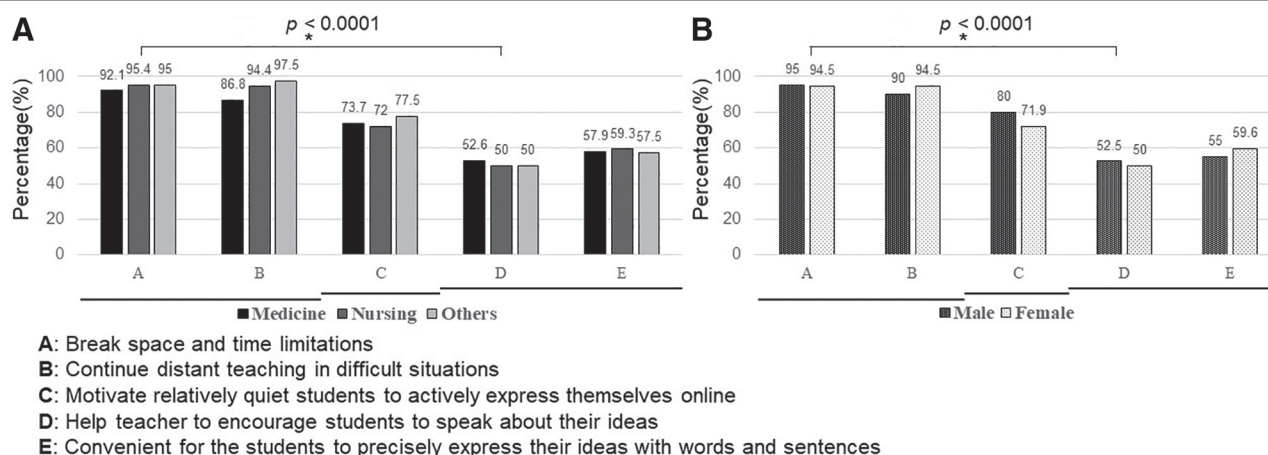
For example, the degree of agreement with Statement A in medical faculty was 92.1%, calculated as the number of medical faculty who chose this statement, divided by the total number of medical faculty (Fig. 1A). Other degrees of agreement were calculated in the same way as can be seen in Figs. 1–3.

For all clinical teachers, whether in medicine, nursing, or other professions, the degree of agreement with the statement regarding the advantage of virtual classes did not differ between groups (Fig. 1A). Meanwhile, the degree of agreement with Statement A (“Break space and time limitations”) was higher for all the teachers than the other four statements [(Fig. 1A: B–E); B = “Continue distant teaching in difficult situations,” C = “Motivate relatively quiet students to actively express themselves online,” D = “Help teacher to encourage students to speak about their ideas,” and E = “Convenient for the students to precisely express their ideas with words and sentences”]. Agreement with Statement D was lower than the other four statements. There was a significant degree of agreement between Statements A and D (Fig. 1A). With regard to gender, the male and female clinical teachers

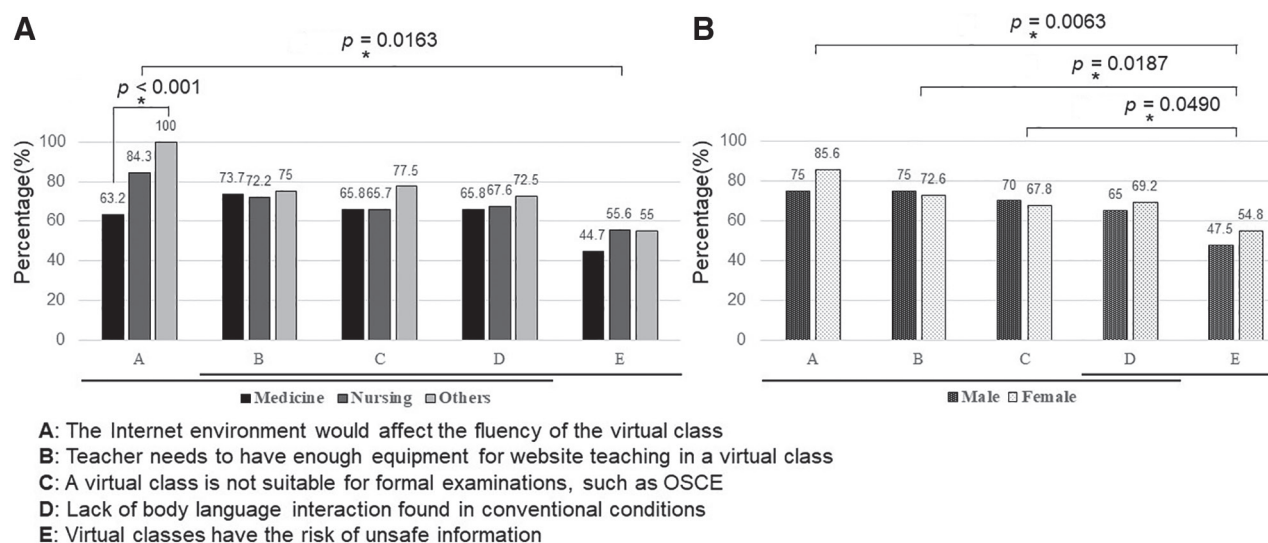
had similar degrees of agreement with the statement about the advantages of virtual classes (Fig. 1B). Furthermore, Statement A had the highest degree of agreement, while Statement D had the lowest (Fig. 1B). There was a significant degree of agreement between Statements A and D (Fig. 1B).

### 3.4. Most of the clinical teachers agreed the Internet environment would affect the fluency of the virtual class

For the clinical teachers, regardless of whether in medicine, nursing, or other professions, their degree of agreement regarding the disadvantages of virtual classes in Statement A “The Internet environment would affect the fluency of the virtual class” (Fig. 2A) was higher than the other four statements [(Fig. 2A: B–E); B = “Teacher needs to have enough equipment for website teaching in a virtual class,” C = “A virtual class is not suitable for formal examinations, such as OSCE,” D = “Lack of body language interaction found in conventional conditions,” and E = “Virtual classes have the risk of unsafe information”]. There was a significant degree of agreement between Statements A and E (Fig. 2A). Regarding Statement A, medicine had the lowest degree, and other professions had the



**Fig. 1** The degree of agreement by clinical teachers of different professions or gender to the advantages of the virtual class: groups differentiated by Tukey's HSD post hoc test. HSD = honest significant difference.



**Fig. 2** The degree of agreement by clinical teachers of different professions or gender to the disadvantages of the virtual class: groups differentiated by Tukey's HSD post hoc test. HSD = honest significant difference.



highest (Fig. 2A). There was a statistically significant degree of agreement with Statement A between medicine and other professions (Fig. 2A). In respect of gender, male and female clinical teachers had similar degrees of agreement with the statement about the disadvantages of the virtual class (Fig. 2B). Furthermore, the top three highest degrees of agreement about disadvantage in descending order were Statements A, B, and C [(Fig. 2B: A–C); A = “The Internet environment could affect the fluency of the virtual class,” B = “The teacher needs to have enough equipment for website teaching in a virtual class,” and C = “Virtual class is not suitable for formal examinations, such as OSCE”]. The degree of agreement with Statement E, “Virtual classes have the risk of unsafe information” (Fig. 2B) was the lowest. There was a significant degree of agreement between Statements E and each of A, B, and C (Fig. 2B).

### 3.5. Most of the clinical teachers reported that the five steps in the virtual class-specific checklist could help them set the virtual class

For all clinical teachers, whether in medicine, nursing, or other professions, the degree of agreement with the statement regarding the essential steps in the virtual class-specific checklist did not differ between groups (Fig. 3A). Meanwhile, the top three highest degrees of agreement about essential steps in descending order were Statements A, B, and C [(Fig. 3A: A–C); A = “Environmental settings (Before),” B = “Creating an encouraging atmosphere (Process),” and C = “Listening (Process)”]. The degree of agreement with Statement E, “Feedback and evaluation (Before the end)” was the lowest (Fig. 3A). There was a significant degree of agreement with Statements E, and each of A, B, and C (Fig. 3A). For gender, both male and female clinical teachers had a similar degree of agreement to the statement about essential steps (Fig. 3B). Moreover, the degree of agreement with Statement A was higher than the other four statements, while Statement E was the lowest among both genders. There was a significant degree of agreement between Statements A and E (Fig. 3B).

### 3.6. Most of the participants agreed that the operating room was the most difficult teaching scenario

The degree of agreement with the statement about the “Operating room” in medical faculty was 36.8%, calculated as the number

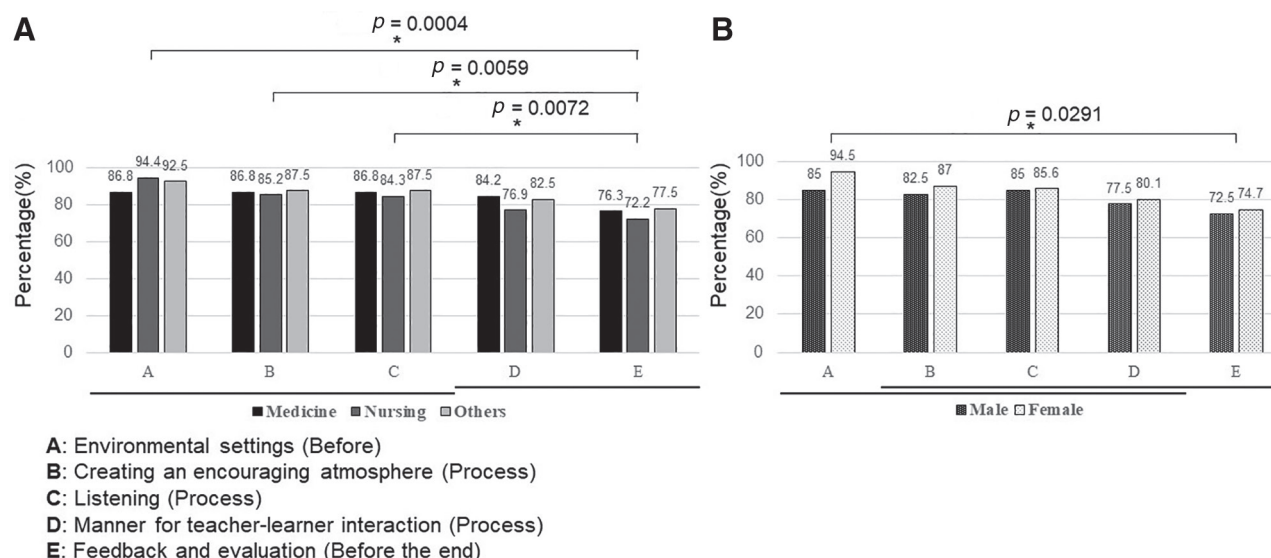
of medical faculty choosing the statement, divided by the total number of medical faculty (Fig. 4B). The remaining degrees of agreement were calculated in the same way (Fig. 4B and D).

The degree of clinical teachers’ agreement with the statement “The essential steps for setting a virtual class should be different by teaching scenarios” was the same between medicine, nursing, and other professions, as well as between males and females (Table 6). Irrespective of whether medical faculty or not, all of them agreed that the most difficult teaching scenario to apply the essential five steps of setting a virtual class is the operating room (Fig. 4A, B). The medical faculty found the easiest teaching scenario to be small group teaching (Fig. 4A, B). Meanwhile, the other clinical teachers found the easiest scenario to be the teaching clinics (Fig. 4A, B). Conversely, for medical faculty who mainly teach in the operating room, the most difficult teaching scenario is teaching clinics, and the easiest is small group teaching (Fig. 4C, D). Meanwhile, for those in medical faculty who do not teach in the operating room, the most difficult teaching scenario is the operating room, and the easiest is small group teaching (Fig. 4C, D).

## 4. DISCUSSION

Recently, for medical students in developed countries, virtual teaching has received much praise.<sup>4</sup> Virtual conferences were introduced as a valuable means of medical education in both surgical and medical specialties, and there was a rapid implementation of this technology.<sup>16</sup> In this study, we found that the absolute number and proportion of virtual faculty training courses in our institution significantly increased from 2018 to 2021. Our result was consistent with global trends, revealing that virtual teaching has become an essential method in modern medical education.<sup>9</sup> In response to this trend, our institution’s division of faculty development designed the virtual class-specific checklist and workshop for setting a virtual class. This approach was supported by an integrative review showing that institutional support was crucial to implementing virtual teaching and learning.<sup>10</sup>

According to our study, although teachers mostly agreed that the virtual class could break space and time limitations, they found it difficult to encourage students to speak about their ideas in the virtual class. The limited interaction between the



**Fig. 3** The degree of agreement of clinical teachers to essential five steps in the virtual class-specific checklist for setting a virtual class: groups differentiated by Tukey’s HSD post hoc test. HSD = honest significant difference.

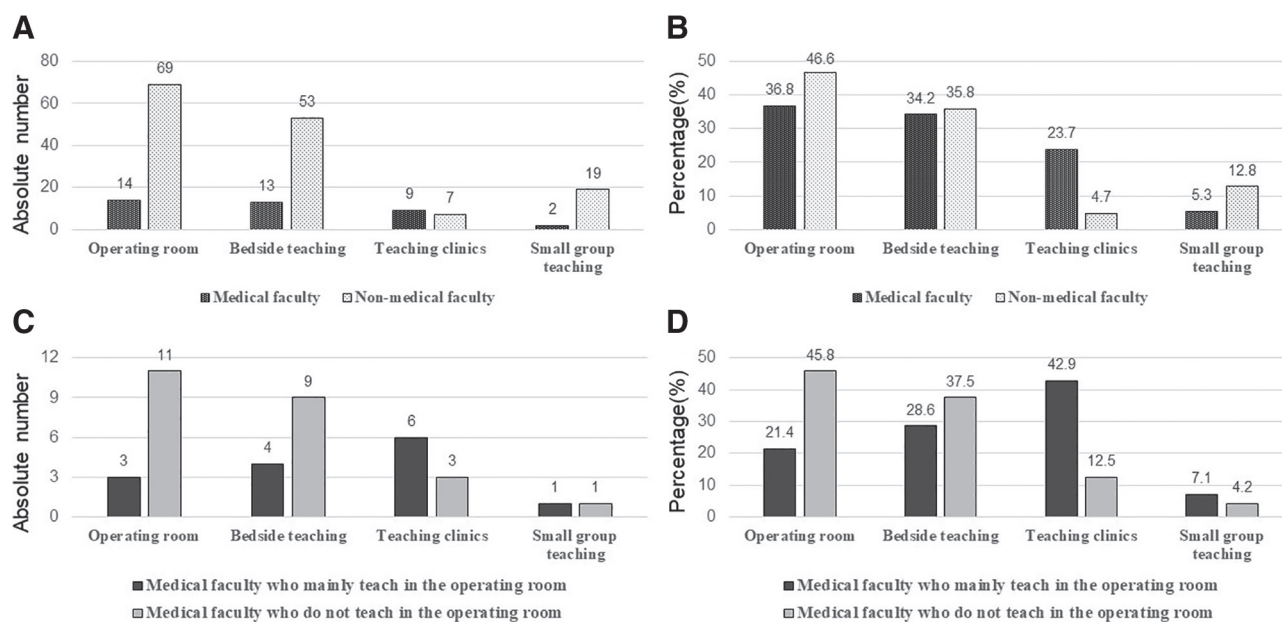


Fig. 4 The distribution of the most difficult teaching scenario to apply the essential five steps in the virtual class-specific checklist for setting a virtual class.

Table 6

Clinical teachers' perception of the essential five steps in the virtual class-specific checklist for setting a virtual class

Variables	Number of clinical teachers	The essential steps for setting a virtual class should be different by teaching scenarios		p <sup>a</sup>
		Agree (%)	Disagree (%)	
Discipline				0.2659
Medicine	38	32 (84.2%)	6 (15.8%)	
Nursing	108	94 (87.0%)	14 (13.0%)	
Others	40	38 (95.0%)	2 (5.0%)	
Gender				0.2664
Male	40	32 (80.0%)	8 (20.0%)	
Female	146	127 (87.0%)	19 (13.0%)	

<sup>a</sup>Comparisons of categorical variables were analyzed using chi-square test or fisher's exact test as appropriate.

teacher and students is a common disadvantage in the virtual setting, thus capturing signals such as body language and eye contact was not as accurate as in a conventional setting.<sup>30,31</sup> As for students' learning motivation, current studies have revealed equivocal results.<sup>4,30,32,33</sup> One study assumed that increased flexibility might encourage self-directed learning and motivation,<sup>4</sup> while others showed that in a virtual class students are under less supervision, making it more difficult for them to maintain focus and concentration in front of a screen because they may be distracted by their surroundings.<sup>30,32,33</sup>

Regarding the disadvantages of the virtual class, our study showed that teachers were mainly concerned that the Internet environment would affect the fluency of the virtual class. This was consistent with the majority of studies indicating that a major disadvantage of virtual teaching is technical difficulties, including no access to digital technology, problems with hardware and software for virtual learning platforms, and challenges establishing a reliable Internet connection, as well as problems relating to the Internet speed and quality.<sup>4</sup> However, teachers of medicine did not consider the Internet environment as having that much of an effect on the fluency of the virtual class. This could be explained by the fact that some of the medical teachers are already familiar with Internet-related equipment,

and younger students are digital learners who have grown up with easy access to digital information and communication technologies.<sup>9</sup> Other research raised concerns about confidentiality and security issues, but in this study, teachers were least worried about the risk of unsafe information.<sup>34</sup> The department of information management of our institution is dedicated to maintaining information security and the online course platform only provides access to faculty, which may explain these findings.

In our study, most teachers, regardless of their professions or gender, agreed that the environmental setting was the most important in the essential five steps. This may be related to the fact that most teachers believe that the major disadvantage of virtual classes is that the Internet environment would affect the fluency in a virtual class. The environmental setting step resolved this disadvantage, serving to help familiarize the teacher with the virtual class setting. On the other hand, they did not think feedback and evaluation were quite as important, as it is difficult to evaluate students' performance in a virtual class and give feedback when the students were not focused.

In our study, the operating room was considered the most difficult scenario for a virtual class setting by most teachers. However, those primarily teaching in the operating room disagreed. The following reasons may explain this finding. Teachers

who do not mainly teach in an operating room might not realize the practicality of virtual classes in the operating room. Their agreement that this was the most difficult scenario may be based on their perception according to personal experience. Nonetheless, teachers who teach mainly in this space know the actual online teaching practice in the operating room. Furthermore, as digital natives, doctors tend to be more proficient in digital technology.<sup>35</sup> Several aspects of surgery have been influenced by digital technology, including surgical techniques and training, and future surgeons will need to integrate technology into their daily practice.<sup>36</sup> Furthermore, it has been mentioned in other research that teachers often feel incapable of teaching students in the clinical settings of other health professions.<sup>15</sup> For all the reasons discussed above, those who mainly teach in an operating room are able to do so with greater ease than those who do not.

Clinical skills, including history taking, physical examination, differential diagnosis, and procedures, are crucial for the training of future physicians.<sup>37,38</sup> These skills could be classified as practical or cognitive skills that require a different method of teaching.<sup>37</sup> To teach practical skills, teachers should provide learners with opportunities for repeated practice, and hands-on clinical experience is especially important in surgical education.<sup>37,39</sup> Clinical teaching in the operating room includes surgical skills and live demonstration of surgical procedures.<sup>8</sup> That said, there was a more significant challenge to teach and set a virtual class for the surgical training course, as it is challenging for current virtual platforms to address the lack of intraoperative experiences during the operation.<sup>8,39</sup>

This innovative technology was established to provide surgical trainees with a real-time, first-person view to learn surgery via surgical live streaming, where students can interact with the surgeon during the operation.<sup>40</sup> The concept of livestream surgery was initially described in 2002 by Gandsas et al,<sup>41</sup> when the technology was not capable of providing real-time delivery of information via the Internet. Now, the development of the 5G network could assist in the area of streaming.<sup>42</sup> A review article has recently introduced several video-capturing devices such as smart glasses and the GoPro for live surgical streaming.<sup>40</sup> However, there are limitations noted by this review, and the patient's safety and privacy are the first priority to be considered before implementing this new type of surgical learning.<sup>40</sup> Surgical outcomes should not be influenced by live streaming, and the patient's information should be secured and supported under definitive protocols such as the Health Insurance Portability and Accountability Act (HIPAA) for protection.<sup>40,43</sup>

Furthermore, the operator may be influenced by the technical devices, including discomfort from the compression and weight of devices, immobility, concern about disrupting an aseptic environment, and stress as the operation is recorded and seen by many viewers.<sup>40</sup> As for the technical aspects, operators should be fully aware of the battery life of the devices, as some operations take longer than others; in addition, the lighting in the operation room has to be adjusted as required to avoid overexposing the video.<sup>40</sup> Due to these limitations, specific guides or rules were required before the setting of online stream surgery.<sup>40</sup>

In our study, the most difficult scenario (operating room) assumed by the majority was not considered difficult by those who teach primarily in the operating room, implying that the essential five steps in the virtual class-specific checklist are suitable for setting a virtual class in the operating room, and hence that there is no need for revising this virtual class-specific checklist in different scenarios. However, as more innovative formats of online learning such as livestream surgery emerge, the virtual class-specific checklist should be further adjusted accordingly.<sup>36,40</sup>

This stepwise cross-sectional study investigated clinical teachers' perception of online learning under different teaching scenarios with a proposed virtual class-specific checklist and training programs to help them face the shift in medical education. However, there are several limitations in our study. First, it is a single-center study, with a limited sample size and there is currently no practice of online learning via innovative formats such as livestream surgery in our institution. Furthermore, the evaluation of our training programs using Kirkpatrick's model (Kirkpatrick, 1996) only reached level 1 (reaction) and level 2 (learning).<sup>44</sup> There are no assessments of the teacher's ability to use their newly learned skills or the impact after these training programs, which are level 3 (behavior) and level 4 (results).<sup>44</sup>

In conclusion, after investigating the clinical teachers' perception of virtual classes and their acceptability of the virtual class-specific checklist, we found that faculty training for setting of virtual teaching is essential, and the essential five steps in the virtual class-specific checklist are suitable for different teachers and teaching scenarios. As more innovative technology for online learning such as livestream surgery emerges, the virtual class-specific checklist should be further adjusted according to accompanied limitations, including the patient's safety and privacy, the influence on the operator, and technical settings.

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