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The impact of online vs. blended clinical skill laboratories (CSL) learning on student academic performance: a case study in Indonesia

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ABSTRACT

Objective: Online and blended learning methods have experienced rapid growth in higher education due to the COVID-19 pandemic. Our study aimed to compare students' academic performance between online and blended Clinical Skill Laboratories (CSL) learning in undergraduate medical students.

Methods: A total of 101 undergraduate medical students at Maulana Malik Ibrahim State Islamic University, Malang, Indonesia, were enrolled (50 students from the academic year 2020 (group 1: online CSL); 51 students from the academic year 2020 (group 2: blended CSL)). The main outcome was students' academic performance collected from the Objective Structured Clinical Examination (OSCE) score. Additionally, students also completed an evaluation questionnaire to assess the quality of the learning scheme.

Results: Both groups agreed that CSL is an important subject and clinical video demonstration is useful for their OSCE preparation. However, students who received online learning felt that online CSL was ineffective and scored lower in the OSCE compared to the blended CSL. Qualitative data also supported these findings.

Conclusion: blended learning provides more value than online learning in terms of teaching clinical skills for undergraduate medical students. Additionally, online CSL may not be sufficient for medical students to attain critical skills.

Keywords: Medical education research, Clinical Skill Laboratories (CSL), online learning, blended learning, students' performance.

1. INTRODUCTION

Clinical skill competency is essential in medical education, and the medical faculty is obliged to provide appropriate clinical skill courses and Objective Structured Clinical Examination (OSCE) to ensure that students clinical skills fulfill standards ¹. Recently, due to the COVID-19 pandemic, many medical faculties have faced the challenge of redesigning their course delivery. In Indonesia, the large-scale social restrictions were implemented in March 2020. During this time, universities were forced to restrict all learning and teaching activities and shift to online delivery. In response to the situation, many medical faculties conducted their Clinical Skill Laboratories (CSL) through online platforms with several activities mimicking face-to-face class learning. As the COVID-19 cases declined, universities, as well as faculties, attempted to combine both distance learning (online) and classroom learning (offline), particularly for hands-on medical skills.

Delivering CSL and OSCE through the online platform is a complex task that requires intricate logistical planning ². And although virtual OSCE is achievable and provides a wide range of clinical skills remotely ³, several limitations should be noted such as the lack of physical examination maneuvers, the inability of examiners to comprehensively assess the skills, and poor internet connection quality and stability ^{4,5}. A recent study has shown that the pandemic significantly hampered the learning outcomes of medical students ⁶. Indeed, although e-learning may assist the teaching process, this delivery method may not be implemented as the sole approach, especially for medical students ⁷. Hence, our study aimed to compare the effectiveness between online vs. blended CSL by evaluating the student

academic performance through the assessment based on the OSCE scores. Furthermore, the acceptance of online CSL delivery by the students was also assessed.

2. METHODS

Firstly, we would like to outline the medical degree program in Indonesia. The medical degree at Maulana Malik Ibrahim State Islamic University is comprised of a 3.5-year undergraduate degree followed by a 2-year clinical rotation. CSL was taught every semester of the undergraduate phase (from 1st – 7th semester) and summative OSCE was conducted at the end of each semester. In response to the COVID-19 pandemic, modifications of the CSL delivery method was implemented. CSL was taught in two different schemes (**Fig. 1**), a completely online or blended scheme for students in the academic year 2020 and 2021, respectively. The preparation section was conducted in two steps, in the first step, all students were required to watch the clinical skills video demonstration made by a lecturer through the e-learning platform (asynchronous learning) and then followed by a post-test. The second step consisted of 3 activities (synchronous lessons (theoretical and practical techniques with the instructor), student video presentation (all students required to make a clinical skill video with the improvised tools; for the online group) or independent-study in the CSL room (for the blended group), and mock test (students performed clinical skill based on the clinical scenario and the instructor provided immediate feedback and engaged in discussions after completing the exam. This approach aimed to assist students in becoming more familiar with the OSCE format and situation). It is important to note that during the second step, all students participated in their respective assigned activities. However, it is crucial to acknowledge that the level of engagement in the independent study varied among students, with some being more active compared to others. In the end, students' performance was evaluated by the OSCE (**Fig. 1**). However, to preserve OSCE validity and reliability, OSCE was conducted offline with strict health protocols and by reducing station numbers (normally

6 stations in each summative OSCE, but during the pandemic, only 4 stations were examined). OSCE-1 is specifically designed for students in their first semester, and it was originally scheduled to take place at the end of that semester, typically in December every year. However, due to government regulations in response to the COVID-19 pandemic during 2020, the scheduling of OSCE-1 was affected due to concerns regarding the effectiveness and validity of conducting the OSCE-1 examination in an online format. Thus, OSCE-1 was conducted in May and December 2021 for students in the academic year 2020 and 2021, respectively.

A total of 101 participants were included in the study, consisting of all students from the academic year 2020 ($n = 50$, group 1) and 2021 ($n = 51$, group 2). The sampling method employed was total sampling, meaning all students from both academic years were taken into account for the study. The two cohorts are considered comparable since both groups had the same exposure to CSL-1 and OSCE-1 in their first semester. More specifically, it is important to note that the scenarios utilized for the OSCE-1 examination were the same for both groups to ensure that any performance differences between the two cohorts can be more confidently attributed to the class scheme (online vs. blended). Moreover, the consistent use of the same scenarios may help to minimize potential confounding factors and strengthens the validity of the comparison between the two groups. Topics to be evaluated at each OSCE station were selected based on inclusion in the CSL-1 syllabus. The exact stations and CSL-1 syllabus are depicted in **Table 1**.

The questionnaire consisted of 10 questions (as seen in **Table 2**). Questions 1 to 8 asked students to rate their agreement with several statements regarding the CSL delivery scheme using Likert scale. In questions 9 and 10, students were asked the overall score of the CSL delivery scheme and to provide free text general feedback of the scheme as a whole and

how it could be improved, respectively. Students' academic performance was evaluated based on their final OSCE score collected from e-OSCE.

Statistical analysis for all Likert scale between two groups was analyzed using the Mann-Whitney test. While the overall score of the CSL delivery scheme, post-test, and student academic performance were analyzed by the independent T-test. GraphPad Prism (Version 9.0) was used for statistical analysis and graph construction. Tableau Public was used to visualize Likert scale data. The p -value < 0.05 was considered significant.

3. RESULTS

We used a total sampling method, in which all students in the academic year of 2020 (group 1, online) and 2021 (group 2, blended) participated and completed the questionnaire. Both groups agreed or strongly agreed that CSL is an important subject for their future profession (group 1 (100%) vs. group 2 (100%), $p = 0.426$, **Fig. 2**). Whilst both groups agreed or strongly agreed that the clinical video demonstration is useful for their OSCE preparation (group 1 (100%) vs. group 2 (94%), $p = 0.983$, **Fig. 2**) a larger proportion of group 2 (94%) agreed or strongly agreed that they expected to get a high post-test score by watching the clinical video demonstration to the end, relative to only 76% of participants in group 1 ($p = 0.025$, **Fig. 2**).

All participants in group 2 agreed or strongly agreed that step 2 is useful, while half of participants (50%) in group 1 disagreed that they found it useful ($p < 0.0001$, **Fig. 2**). In line, 98% of participants in group 2 agreed or strongly agreed with the statement that they found the mock test was helpful to refresh their memory, while only 59% of part participants in group 1 agreed or strongly agreed with that statement ($p < 0.0001$, **Fig. 2**). It is interesting to note that more than half of participants (60%) in group 1 disagreed or strongly disagreed that the time in each step was sufficient (vs. 4% in group 2, $p < 0.0001$, **Fig. 2**). Although the

majority of students valued the new delivery scheme for their learning, particularly when they were not able to attend the clinical skills class or they have limited activity and time due to the COVID-19 pandemic, students with online CSL have encountered many more challenges than blended CSL that we summarized in a relevant theme as mentioned in **Table 3**.

Nearly 30% of students in group 1 thought that the learning scheme was not acceptable or suitable (vs. 4% in group 2, $p = 0.0002$, **Fig. 2**). Additionally, less than half (48%) of students in group 1 thought that their score was satisfactory (vs. 86% in group 2, $p = 0.0008$, **Fig. 2**). We did not find any significant difference in the post-test scores between the groups (**Fig. 3A**). Nonetheless, the overall score for the online CSL delivery scheme was significantly lower than the blended CSL scheme (6.2 ± 1.7 vs. 7.9 ± 1.1 , $p < 0.0001$, **Fig. 3B**). This difference in scores could potentially be attributed to the fact that students' academic performance (*e.g.* OSCE score results) in group 1 was generally lower than group 2, as depicted in **Fig. 3C**.

4. DISCUSSION

Our study demonstrates differences in students' academic performance, as evidenced by the OSCE scores, between students receiving online and blended CSL schemes. These differences strongly imply that the skill acquisition of medical students has been adversely affected due to the changes resulting from the COVID-19 pandemic. The students' academic performance was significantly lower in the academic year 2020 (online scheme) than in 2021 (blended scheme), indicating a lack of skill acquisition during the online clinical training. It is not unexpected to observe this outcome, as students with online clinical training may have diverse perceptions and perspectives on how practical activities should be performed. Moreover, several barriers associated with online teaching platforms, such as family

distractions and inadequate internet connections, could have further hindered the students' learning experience⁸.

While we did not find a significant difference in post-test scores between groups, there are various reasons why the students in group 1 found their post-test score unsatisfactory according to the personal interview, 1) the clinical video demonstration may be too long for their full engagement, 2) low motivation due to no direct interaction with their instructor, 3) limited time with a pressure to get a high score, and 4) the students may not fully recognize the medical equipment that was used in the video. Hence, it is important to make the video more precise and informative as much as possible, in accordance to previous studies which indicate that video clips with a length of 10 – 20 minutes provide a positive impact on students learning of clinical skills⁹. Another factor to consider that could have influenced the lower OSCE scores observed in group 1 is the incidental 5-month delay of the OSCE-1, which may have resulted in reduced recall performance¹⁰.

In line to the previous finding¹¹, our results further support the notion that majority of students perceive online learning as being less effective, particularly when it comes to gaining practical experiences. While post-graduation continuing medical education programs may help in addressing this concern¹², it is essential to recognize the potential long-term negative impact of these results for the future clinical competence of medical professionals. Based on the aforementioned findings, we conclude that online classes may not be sufficient for students to learn critical clinical skills. Our observations point to several major drawbacks of the online method. Firstly, students face a major challenge to acquire sufficient clinical medical skills, especially due to the lack of hands-on training. Secondly, we found that the online method resulted in a significantly lower student academic performance. Indeed, it is believed that the lack of hands-on training in the preclinical study may have significant implications during their clinical rotation¹³. Furthermore, our results were also in agreement

with previous notions that blended learning provides better pedagogical value compared to online learning¹⁴.

In conclusion, our study showed that blended classes had added value compared to online classes in terms of teaching clinical skills for undergraduate medical students, as measured by their attitude towards learning modality, level of satisfaction, and academic performance. Additionally, our current findings also strengthen the existing evidence that blended learning for clinical skills is feasible in this current situation. Further studies are still required to examine the longer-term effects between blended vs. classroom CSL for undergraduate medical students.

AUTHOR CONTRIBUTION

ZSU.: Conceptualization, Data curation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing.

FNN, ANA, AAH: Data curation

GVS, LAI, SAP, ARS: Writing – original draft, Writing – review & editing.

CONFLICT OF INTEREST

None to declare

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COMPLIANCE WITH ETHICAL STANDARDS

Ethical approval: The study was approved by the Research Ethics Committee of the Faculty of Medicine and Health Sciences, Maulana Malik State Islamic University of Malang, Indonesia.

Informed consent: The study was conducted according to the criteria set by the declaration of Helsinki and informed consent was obtained from each participants before participating to the study.

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FIGURE CAPTIONS

Fig. 1. Illustration of learning delivery scheme applied to each group.

Figure 1

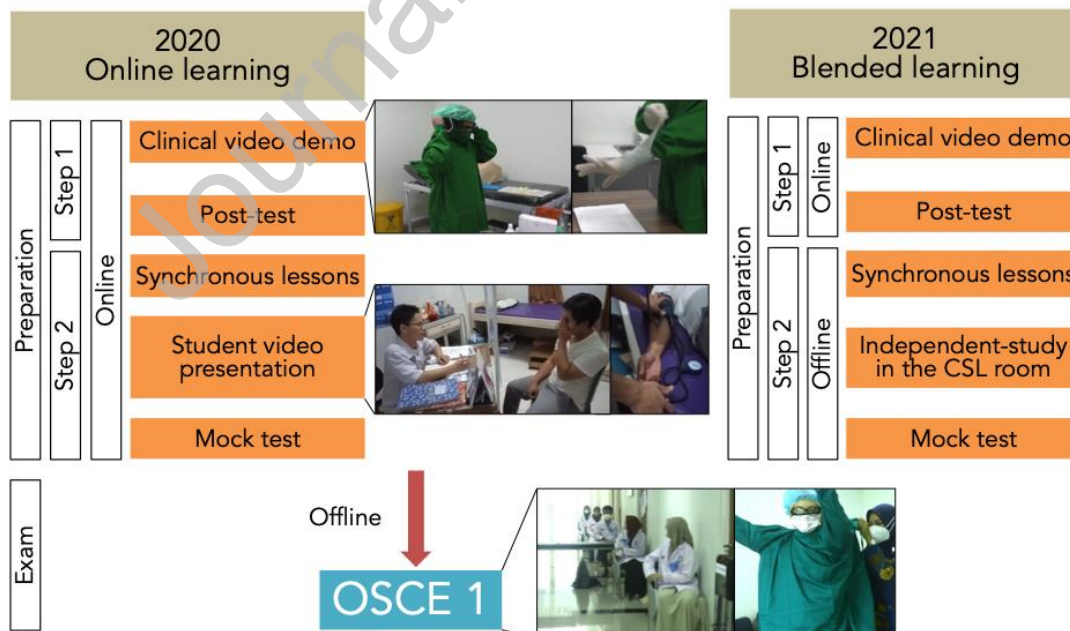


Fig. 2. Student opinions on their learning delivery scheme to questions asked in Table 2.

**** $p < 0.0001$; *** $p < 0.001$; * $p < 0.05$; ns = not statistically significant.

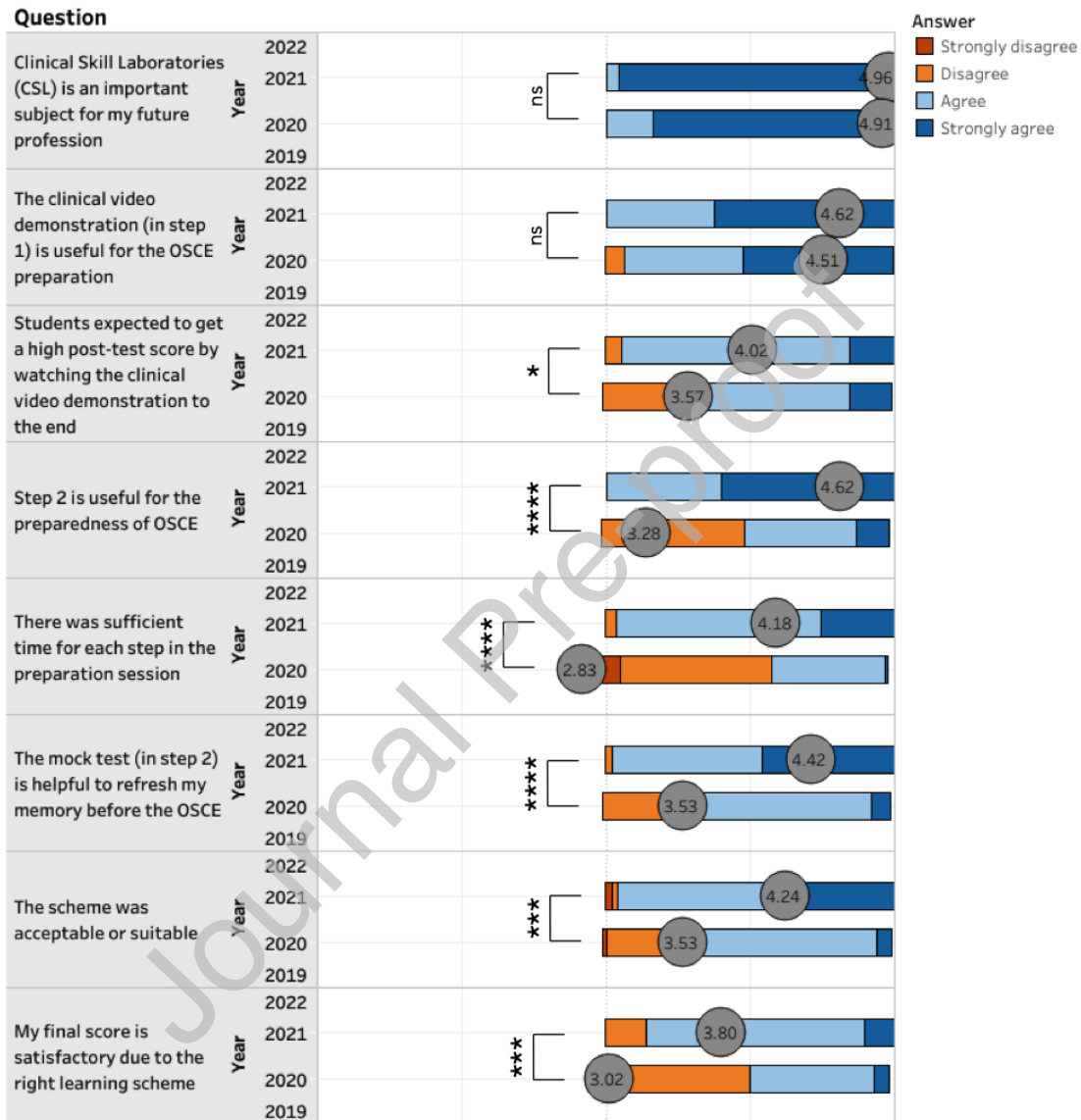
Figure 2

Fig. 3. (A) Post-test score according to each topic between groups. (B) The overall score of the learning delivery scheme in each group. (C) Student performance score in each station between groups. **** $p < 0.0001$; *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; ns = not statistically significant. Detailed of topics and stations are depicted in Table 1.

Figure 3

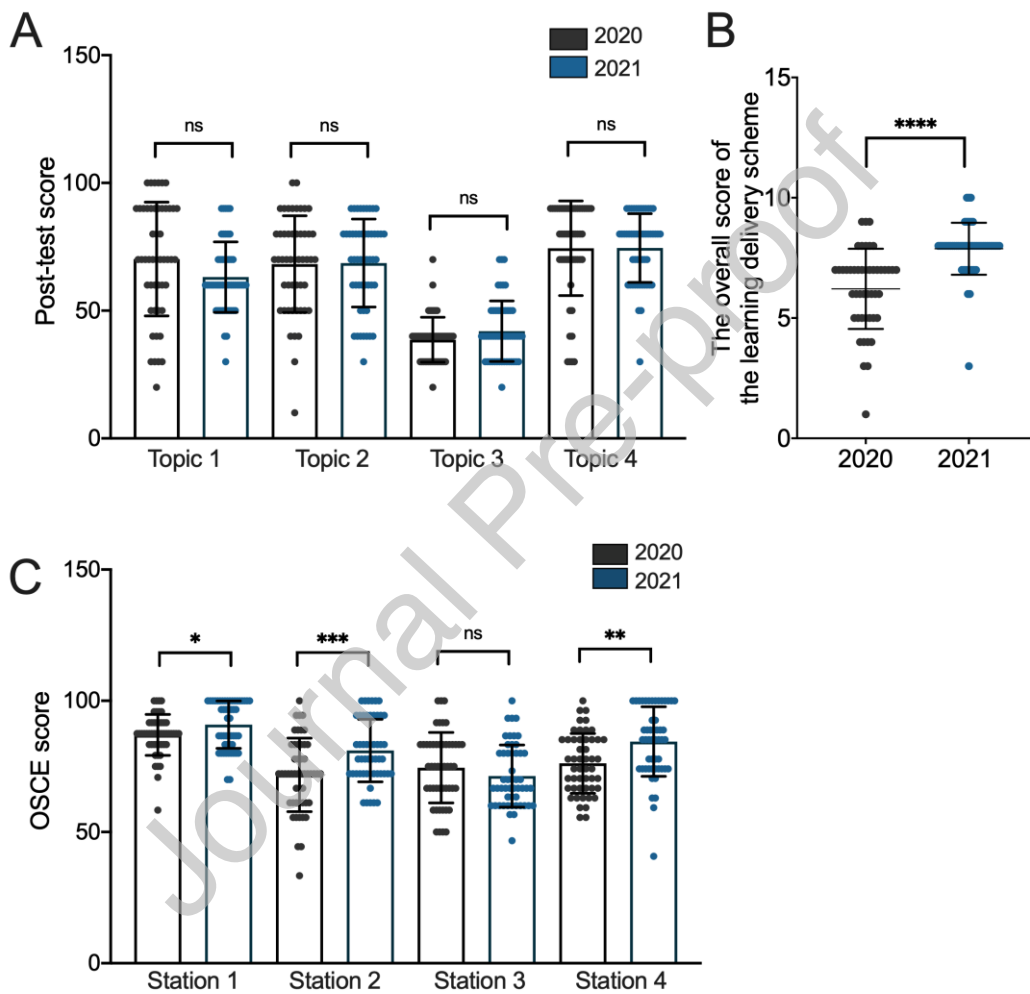


Table 1. CSL-1 syllabus and topics examined at each station in OSCE-1

CSL-1 Syllabus		OSCE-1	
Topic		Station number	
1.	Interpersonal communication	1	Clinical history taking
2	Anamnesis and medical record	2	Aseptic technique (surgical skin disinfection)
3	Aseptic technique - Universal precaution - 7 steps hand washing - Principles of appropriate use of disposable gloves - Scrub, Gown, and Glove Procedures - Surgical skin disinfection - Sterilization and disinfection equipment	3	Vital sign examination
4	Vital sign assessment	4	Aseptic technique (surgical gown technique)

Table 2. Feedback questionnaire

QuestionID	Question	Answer
Q1	Clinical Skill Laboratories (CSL) is an important subject for my future profession	
Q2	The clinical video demonstration (in step 1) is useful for the OSCE preparation	
Q3	Students expected to get a high post-test score by watching the clinical video demonstration to the end	
Q4	Step 2 is useful for the preparedness of OSCE	
Q5	There was sufficient time for each step in the preparation session	
Q6	The mock test (in step 2) is helpful to refresh my memory before the OSCE	
Q7	The scheme was acceptable or suitable	
Q8	My final score is satisfactory due to the right learning scheme	
Q9	Provide an overall score for the quality of the learning scheme	1 to 10 scale
Q10	Comments regarding the learning scheme	Free text feedback

1 **Table 3.** Feedback regarding the CSL delivery scheme

Academic year	Thema	Representative quotes	
2020 (group 1)	Skill deficit	<i>"I am anxious and have panic attacks, so I can't perform well during OSCE"</i> <i>"I am not confident in myself and I am confused whether I am getting the right skill"</i> <i>"There are details that can't be seen online"</i>	
	Time/duration of session	<i>"Need more time for hands-on training"</i>	
	Clinical video demo	<i>"In my opinion, the videos are quite helpful, but students still have to look for other related references"</i>	
	Mock test	<i>"Improvising with tools around the house is an obstacle when trying to master the skills"</i>	
	Desire for supervision	<i>"I think we need the opportunity to learn together with the instructor/doctor"</i>	
	Desire for more training	<i>"Online CSL is very helpful indeed. But, apart from that, we have to practice directly"</i> <i>"Need more practice"</i>	
	Student video presentation	<i>"Making a video is quite time-consuming"</i>	
	Medical equipments	<i>"The delivery method for 2020 was good. But we could not see clearly the equipment used, and we were often confused during OSCE"</i> <i>"In my opinion, the online learning for 2020 is less effective because we do not really know the tools that will be used during exam"</i>	
	Online/Offline learning	<i>"Offline learning (directly on campus) is likely to produce better outputs than the existing ones"</i> <i>"Personally, I prefer if everything was done offline. I think hands-on experience is important in learning clinical skills"</i> <i>"Online learning is less effective"</i>	
	2021 (group 2)	Skill deficit	<i>"Each detailed step taught by the instructor during the offline session is very helpful, easy to follow, and makes me prepared for the upcoming exam"</i>
		Time/duration of session	<i>"We have more time during self-learning, learning clinical skills from my class fellow is useful"</i>
		Clinical video demo	<i>"The video helped to guide me in learning clinical skills before OSCE"</i>
Mock test		<i>"Mock test before OSCE is very helpful"</i>	
Desire for supervision		<i>"The session with the instructor is good as we gain more experiences from them"</i>	
Desire for more training		<i>"Learning together with my classmates is quite good because I can exchange the ideas with them"</i>	
Independent-study		<i>"Without making video, independent-study in campus really helped me to pass the OSCE"</i>	
Medical equipments		<i>"Introduction of medical tools during face-to-face class helped me to understand the procedure easily"</i>	
Online/Offline	<i>"Very effective in pandemic situation"</i>		

learning

“In my opinion, blended CSL for 2021 is easy to understand”

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4 **Declaration of interests**

5

6 The authors declare that they have no known competing financial interests or
7 personal relationships that could have appeared to influence the work reported
8 in this paper.

9

10 The authors declare the following financial interests/personal relationships which
11 may be considered as potential competing interests:

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