ORIGINAL ARTICLE

Clinical Competence and Learning Environment of Primary Care Medical Students Amid Covid-19 Pandemic: Online Distance Learning Versus Face-to-Face Teaching

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ABSTRACT

Introduction: The COVID-19 pandemic has significantly changed the learning environment for medical students and affected their academic achievement. This study aims to determine the student's clinical competency, learning environment, and its associated factors during the primary care medicine posting amid the COVID-19 pandemic.
Methods: This is a cross-sectional study among medical students who had completed primary care medicine posting during the COVID-19 pandemic. Data on socio-demographic, posting characteristics, and students' learning environment using the Dundee Ready Educational Environment Measure (DREEM) questionnaire and their objective structured clinical examination (OSCE) marks were collected. Independent t-test was used to compare DREEM scores between face-to-face and online groups. Multivariate analysis was used to determine factors associated with clinical competency and DREEM scores with $p < 0.05$ considered significant. **Results:** A total of 205 students were recruited. Only 9.8% failed OSCE. Face-to-face teaching delivery (OR=3.61, 95 CI =1.03,11.30), face-to-face precept method (OR=1.24, 95 CI =1.12,12.51) and integrated curriculum (OR=5.23, 95 CI =1.03,26.47) were associated with good clinical competency. The total mean DREEM score was 72.94 (SD 28.8), with 89.3% having poor DREEM scores. Students who received face-to-face teaching scored higher in the Student's Perceptions of Teacher domain compared to online teaching ($p = 0.036$). **Conclusion:** Face-to-face teaching is preferred for good clinical competence and a learning environment. The impact of experiential learning was huge in our study, and it cannot be replaced by online learning. Furthermore, retraining teachers will improve the online learning experience for the students.
Malaysian Journal of Medicine and Health Sciences (2023) 19(5):89-96. doi:10.47836/mjmhs19.5.13

Keywords: Online learning, clinical competency, learning environment, OSCE, DREEM, COVID-19

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INTRODUCTION

An outbreak of the novel coronavirus disease COVID-19 has caused a worldwide pandemic since December 2019 (1). To halt the infection spread, total lockdowns were imposed on many sectors including the educational sector provided by universities. Medical students were not allowed to continue their clinic or hospital postings to reduce the risk of COVID-19 transmission. This has resulted in the interruption of face-to-face, bedside teaching methods where students learn from clerking, observe consultations, and practice physical examinations on real patients.

To adapt to new norms, learning activities were shifted from face-to-face teaching to online teaching methods. The previous teaching methods include a series of lectures, seminars, clinic attachment, directly observed consultation, and group discussion. Practical sessions to observe consultation, observe or perform procedures, and perform physical examinations are done through clinical attachment. During the movement restriction order (MCO), their clinical attachment was replaced with simulation patients and manikin for procedures and patient consultation.

The main aim of primary care posting is to equip students with adequate knowledge and skills to provide holistic care for all individuals, families, and communities. Concerns regarding medical graduates' competency have been an issue even before the pandemic (2). With the modification of teaching delivery during the pandemic, medical educators have become more

worried about medical graduates' competency levels.

Based on extensive literature reviews, the learning environment has a profound impact on the student's satisfaction, academic achievement, and learning effectiveness (3, 4). Therefore, assessment of students' learning environment is essential to ensure the delivery of high-quality education. The learning environment consists of teaching methods, assessments, physical facilities, the teachers, psychosocial and other elements that the students experience throughout their learning (5). By identifying the status of the learning environment, measures to design online content and conduct of teaching can be improved to suit the program objectives.

There are a number of instruments or tools to measure the learning environment developed over the years for example The Medical School Learning Environment Survey & The Johns Hopkins Learning Environment Scale and DREEM. DREEM was chosen in this study as it was developed and validated specifically on medical students. It has been widely used globally to measure the learning environment in medical schools. Other fraternities are currently adapting this questionnaire in their studies as well. In Malaysia, DREEM is well-validated and has been widely used.

Although studies in other countries showed positive student perception towards the current learning environment during the COVID-19 pandemic (6, 7), there is limited literature on the subject among medical students undergoing primary care medicine posting in Malaysia. There is also a need to study the relationship between their perception of their learning environment and clinical competence to improve any modifiable factors. Therefore, the aims of this study are: 1) to determine the students' clinical competency, 2) to assess the students' perception of their learning environment and 3) to evaluate the association between teaching delivery methods and students' perception of their learning environment with clinical competence during primary care medicine posting amid the COVID-19 pandemic.

MATERIALS AND METHODS

This is a cross-sectional study conducted in a public university. The target population was medical students who had completed their primary care medicine posting in year 4 and were affected by the COVID-19 pandemic from March 2020 to December 2021. The sample size was calculated using the single mean proportion formula for all objectives. The largest sample size was produced based on a study done Al-Naggar et al., who found that the standard deviation of the DREEM score among medical students was 19.5. With a confidence interval of 95%, Z=1.96, and Δ=6, the calculated sample size is 41(8). The questionnaire was given to all students (331) using the Google® link via the Whatsapp® groups. However, only 205 students (61.9%) completed the questionnaire. The questionnaire was distributed on their last day of primary care posting, during the pandemic of COVID-19 from May 2020 to February 2022. The corresponding researcher's contact details were made available to the participants for any queries. Participants informed consent was obtained. Confidentiality and anonymity were strictly kept throughout the study.

The questionnaire consists of three sections: sociodemographic data, clinical rotation characteristics, and the assessment of students' learning environment using the DREEM questionnaire. Socio-demographic data include age, gender, location of the campus, and devices used during online teaching. Information on clinical rotation characteristics such as teaching delivery method (online /hybrid /face to face), exposure to the type of clinic rotation (university clinic/government health clinic), and type of curriculum (integrated/ fragmented) were also obtained. The estimated time consumed to complete the questionnaire was 15-20 minutes.

The clinic rotation refers to the attachment to the government health clinics or the university primary care clinics. Due to the MCO, some students did not get the opportunity to attend those attachments. In terms of curriculum, there are two categories: integrated and fragmented. An integrated curriculum is where students received their theory and clinical teachings in the same block whereas, in a fragmented curriculum, students received their two-week theory block separately from their four-week clinical attachment. Students were exposed to various methods of teaching (predominantly online/ predominantly face-to-face) depending on the Malaysian Movement Control Order (MCO) status at that time. The students were then categorised on the type of teaching delivery received.

The student's perception of their learning environment was assessed using a validated questionnaire, DREEM, developed by the International Delphi panel (9-11). The questionnaire consists of five domains with a total of 50 items. The domains are Students' Perceptions of learning (SPoL) which refers to the student's view of teaching, Student's Perceptions of Teachers (SPoT) refers to the students' views of teachers; Students' Perceptions of Atmosphere (SPoA) refers to the atmosphere in the class or institute; Students' Academic Self-Perception (SASP) refers to the student's feelings about career and approaches to learning; and Student's Social Self-Perceptions (SSSP) refers to the personal life of the students. The individual items are scored using a Likert scale: 4= strongly agree, 3= agree, 2= uncertain, 1= disagree, and 0= strongly disagree. Nine of the items were scored in reverse. A higher score indicates a more positive evaluation, with a maximum score of 200. The marks can also be classified as follows, 0-50 (very poor), 51-100 (plenty of problems), 101-150 (more positive than negative), and 151-200 (excellent). The

previous Malaysian study reported an acceptable level of constancy and a high level of internal consistency of the instrument with Cronbach's alpha values ranging between 0.91 and 0.94 (12).

The student's clinical competency was measured using the OSCE scores obtained at the end of the posting. OSCE scores have been used as a reliable and suitable indicator of student performance, faculty teaching, and curriculum planning (13). At the end of their primary care posting, they were assessed using two simulated consultation stations, an acute and a chronic case. The selection of the cases went through a thorough vetting process by the examiners. The marking scheme is standardised amongst the examiners to reduce interrater variability. The maximum mark is 40 and students with marks of 20 and above will pass the exam and fail if otherwise. Those who passed the OSCE were categorised as clinically competent and those who failed were classified as incompetent.

Data analysis was conducted using Statistical Package for the Social Sciences (SPSS) version 27.0 (IBM). Descriptive analysis was described using mean and standard deviation for continuous data, while number (n) and percentage (%) were used for categorical data.

The determination of factors associated with clinical competence was analysed using simple logistic regression (SLogR). Independent variables with a p-value of <0.25 were further analysed using multiple logistic regression (MLogR) to determine the independent predictors of clinical competency. Simple linear regression (SLR) and multiple linear regression (MLR) were used to find the associated factors of the DREEM scores. The level of significance used for this study was set at a p-value of <0.05.

This study has obtained approval from the Universiti Teknologi MARA Research Ethics Committee [REF: 600-TNCPI(5/1/6)].

RESULTS

A total of 331 year four undergraduate students were given the questionnaires in the Google Form. Out of that, 205 students responded to the questionnaire with a response rate of 61.9%.

Characteristics of the study population

The sociodemographic of the students are described in Table I. The mean age of the students was 23.5 (± 0.81) years. Majority were female (72.2%) and Malay (98.5%). Regarding device usage and internet connectivity, 51.2% of the students used multiple devices, including laptops, tablets, and mobile phones for online teaching, with 46.3% of them using campus Wi-Fi. Many of them were dissatisfied (51.2%) with the internet connection stability in the campus.

Characteristics of the clinical rotation received by the students

As shown in Table I, 78.1% students received predominantly face-to-face teaching while 22% predominantly online. Only 22.4% of the students had experienced health clinic attachment, while 95.1% had their clinical exposure in the university primary care clinics. One of our teaching components is the directly observed consultation teaching method or precept sessions. Precept is conducted in a clinic where student's consultations with patients were evaluated by the lecturers. Among the students, 65.9% had their precept done via face to face. In terms of curriculum, 57.1% had a fragmented type of curriculum. For their theory examination, 98.5% passed their theory exams.

Clinical competency

90.2% passed their OSCE while 9.8% failed the exam. SLogR analysis in Table I was further analysed using MLogR. From the SLogR analysis, the variables selected were the source of internet (p=0.115), satisfaction with campus internet connection (p=0.06), teaching delivery method (p=0.057), government health clinic attachment (p=0.177), precept method (p=0.001), curriculum (p=0.049) and theory examination result (p=0.208). The logistic regression model was statistically significant, $\chi^2(3) = 9.25$, $p<0.001$. The model explained 19.6% (Nagelkerke R^2) of the variance for good clinical competency. Three factors were statistically significant: teaching delivery method (face-to-face vs online), precept method (face-to-face vs video recording), and integrated curriculum vs fragmented curriculum as shown in Table II.

DREEM score

Only 10.7% (n=22) students had good overall DREEM scores, which were determined by the cut-off score of 101 and above. Meanwhile, the majority (89.3%) of the students had poor DREEM scores. According to each domain, the students perceived the learning environment negatively across all five domains as depicted in Table III. The Student's Perceptions of Teachers (SPoT) scored lowest compared to others; particularly, there is a significant difference between mean scores for predominantly face-to-face and predominantly online student groups (p = 0.036) using independent t-test.

Factors associated with the DREEM scores

We analysed using SLR and MLR for the total DREEM score and its five domains. The multivariate analysis on factors associated with total DREEM score and its domains showed that only the type of device used was found to be significant in the Students' Academic Self-Perceptions (SASP) (Table IV). This means that when comparing the other devices with having mobile phones only, students with mobile phones scored better in this domain. No significant factors were associated with the total DREEM score and the other four domains.

Table I : The comparison of clinical competency across the sociodemographic and clinical rotation characteristics (N=205)

Variable	Clinical competency		Total, N (%)	OR (95% CI)	p-value[a]
	Competent (n=185)	Incompetent (n =20)			
Device used during online teaching session					
Laptop/desktop only	60 (92.3)	5 (7.7)	7 (3.4)	Ref	Ref
Mobile phone only	6 (85.7)	1 (14.3)	65 (31.7)	0.53 (0.05, 5.28)	0.585
Tablet/ Ipad only	27 (96.4)	1 (3.6)	28 (13.7)	2.37 (0.26, 21.28)	0.441
Used more than 1 device	92 (87.6)	13 (12.4)	105 (51.2)	0.64 (0.22, 1.89)	0.421
Source of internet					
Campus Wi-Fi	88 (92.6)	7 (7.4)	95 (46.3)	2.18 (0.83, 5.74)	0.115
Mobile data	22 (100)	0 (0)	22 (10.7)	6.71 (0.91, 9.71)	0.998
Use more than 1 source	75 (85.2)	13 (14.8)	88 (43.0)	Ref	Ref
Satisfaction with campus internet connection					
Satisfied	12 (6.5)	2 (10.0)	14 (6.8)	0.36 (0.07, 2.01)	0.246
Neutral	74 (40.0)	12 (60.0)	86 (42.0)	0.37 (0.134, 1.04)	0.060
Dissatisfied	99 (53.5)	6 (30.0)	105 (51.2)	Ref	Ref
Teaching delivery method					
Predominantly face to face	141 (88.1)	19 (11.9)	160 (78.0)	0.17 (0.02, 1.30)	0.057
Predominantly online	44 (97.8)	1 (2.2)	45 (22.0)	Ref	Ref
Government Health Clinic attachment					
Yes	44 (95.7)	2 (4.3)	46 (22.4)	0.36 (0.08, 1.60)	0.177
No	141 (88.7)	18 (11.3)	159 (77.6)	Ref	Ref
University Primary Care Clinic attachment					
Yes	176 (90.3)	19 (9.7)	195 (95.1)	0.97 (0.12, 8.09)	0.979
No	9 (9.7)	1 (10)	10 (4.9)	Ref	Ref
Precept method					
Face to face only	125 (67.6)	10 (50)	135 (65.9)	1.19 (1.01, 5.82)	**0.001**
Hybrid	15 (8.1)	1 (5)	16 (7.8)	1.01 (0.24, 5.82)	0.830
Video recording simulated patients only	21 (11.4)	2 (10)	23 (11.2)	1.43 (0.12, 17.23)	0.779
Online session simulated patients only	24 (13.0)	7 (35)	31 (15.1)	Ref	Ref
Curriculum (theory and clinical)					
Integrated	61 (96.8)	2 (3.2)	88 (42.3)	4.43 (1.01, 19.70)	**0.049**
Fragmented	124 (87.3)	18 (12.7)	117 (57.1)	Ref	Ref
Theory examination result					
Pass	183 (90.6)	19 (9.4)	202 (98.5)	0.21 (0.02, 2.40)	0.208
Fail	2 (66.7)	1 (33.3)	3 (1.5)	Ref	Ref
Total DREEM score					
Good	19 (86.4)	3 (13.6)	22 (10.7)	1.54 (0.41, 5.75)	0.519
Poor	166 (90.7)	17 (9.3)	183 (89.3)	Ref	Ref

Note: [a] p-value from simple logistic regression (SLogR). Statistical significance at p-value<0.05.

Table II: Significant factors associated with good clinical competence (N=205)

Variables	Adjusted OR (95% CI)	Wald a (df)	p-value[a]
Teaching delivery method			
Predominantly face to face	3.61 (1.03, 11.30)	4.01 (1)	**0.007**
Predominantly online	1		Ref
Precept method			
Face to face	1.24 (1.12, 12.51)	8.08 (1)	**0.024**
Hybrid	0.09 (0.01, 1.17)	4.34 (1)	0.858
Online session simulated patients	0.30 (0.09, 0.94)	2.06 (1)	0.151
Video recording simulated patients	1		Ref
Curriculum			
Integrated	5.23 (1.03, 26.47)	3.99 (1)	**0.046**
Fragmented	1		Ref

Note: [a] MLogR: Backward LR method (Nagelkerke $R^2 = 0.196$). Statistical significance at p-value < 0.05.

DISCUSSION

This study reflects the baseline resources available to support the change from face-to-face to online learning. Predominantly online learning relies heavily on internet connectivity and device availability. In this study, more than half of the students had more than one device at their disposal to use during learning sessions and one-third of the students had mobile phones only. However, in terms of internet connectivity, only 6.8% were satisfied with the internet connection provided with more than half dissatisfied due to frequent network interruptions. These findings echo previous research from the Philipines and Bangladesh whereby students reported internet access to be unsatisfactory (14, 15). Internet connectivity issues may influence their learning environment and disrupt the overall learning experience (16). It is recommended that the university ensure a stable internet connection for all students and lecturers.

Table III: Comparison of the DREEM scores between 'predominantly face to face' and 'predominantly online' groups for each domain (N=205)

Domain	Mean (±SD)	Predominantly face to face	Predominantly online	p value*	Scores Interpretation
Total DREEM score	72.94 (28.81)	73.92 (30.22)	69.47 (23.05)	0.120	0-50 : very poor **51-100: plenty of problems** 101-150: more positive than negative 151-200: excellent
Students' Perceptions of learning (SPoL) - 12 items	16.48 (7.47)	16.78 (7.78)	15.40 (6.22)	0.274	0-12 very poor **13-24 teaching is viewed negatively** 25 - 36 more positive perception 37-48 teaching highly thought of
Student's Perceptions of teachers (SPoT) - 11 items	13.26 (7.64)	13.79 (8.06)	11.40 (5.57)	**0.036**	0-11 abysmal **12-22 in need of some retraining** 23-33 moving in the right direction 34-44 model teachers
Students' Perceptions of atmosphere (SPoA) - 12 items	19.49 (7.74)	19.41 (7.99)	19.78 (6.82)	0.175	0-12 terrible environment **13-24 there are many issues which need changing** 25-36 a more positive atmosphere 37-48 a good feeling overall
Students' Academic Self-Perceptions (SASP) - 8 items	11.57 (4.23)	11.72 (4.45)	11.02 (3.31)	0.096	0-8 feeling of total failure **9-16 many negative aspects** 17-24 feeling more on the positive side 25-32 confident
Students' Social Self-Perceptions (SSSP) - 7 items	10.09 (4.22)	10.13 (4.45)	9.93 (3.31)	0.086	0-7 miserable **8-14 not a nice place** 15 -21 not too bad 22 - 28 very good socially

*using independent t-test. Statistical significance at p-value < 0.05.

Table IV: Significant factors associated with SASP domain score

Device used	SLR[a]		MLR[b]		
	b (95% CI)	p-value	Adj. b (95% CI)	t-stat	p-value
Mobile phones only	Ref		Ref		
Laptop/desktop only	-4.53 (-7.81,-1.25)	**0.007**	-5.70 (-9.36, -2.03)	-3.07	**0.002**
Tablet/ipad only	-3.64 (-7.13, -0.16)	**0.04**	-4.73 (-8.59, -.87)	-2.42	**0.017**
More than 1 device	-4.32 (-7.54, -1.11)	**0.009**	-5.31 (-8.75, -1.87)	-3.05	**0.003**

Note: [a]Simple linear regression. [b]Multiple linear regression (R^2=0.038).

In this study, it was found that less than a quarter of the students had attended government health clinics attachment. This is due to a limited session of health clinic attachments available to reduce exposure to COVID-19 at a time when the students are not yet fully vaccinated. Therefore, this might jeopardise their clinical skills and experience. The government health clinics received a large number of patients and provided extensive services including maternal and child health, addiction clinic, and screening services. Based on the literature review, the key factors for successful training are patient contact, observing a variety of clinical presentations, and learning to be part of a team (17).

The total DREEM score and all its subdomains are low, reflecting students perceived their learning environment more negatively for all domains during the COVID-19 pandemic. The possible reasons for this are reduced contact hours, lack of consultation when students face difficulties, and ad hoc implementation of online learning and assessment. Students and teachers need time to adapt to the newly implemented methods that involv multiple trials and errors. This is in contrast with other studies where the participants scored higher DREEM scores indicating that despite the challenges during the pandemic, the students were still able to perceive their learning environment positively (18-21). It highlights the difference in learning environment variations.

The total DREEM score for face-to-face teaching fared higher than online teaching possibly because students prefer face-to-face classes when it involves the learning of conceptual knowledge or the application and acquisition of skills (22). There is a statistical difference between online and face-to-face in the Student's Perceptions of teachers (SPoT) domain likely due to a lack of student-teacher engagement during online teaching. This contradicts another study that showed that students perceived a stronger teacher and social presence in the online section compared to the face-to-face section (23). Hence, training teachers for effective online teaching of conceptual knowledge and skills are necessary.

Students who used mobile phones only have better SASP scores. Smartphones are convenient due to their compact size and ease of access by medical students during clinic attachment or teaching and learning sessions. In a study amongst medical students by Thakre et al., smartphones were used extensively for social communication, while more than 50% were used for academic purposes such as browsing quick information through the internet and medical apps (24). The practicality of many emerging user-friendly medical apps also helped the students in their learning and decision-making process. A study done among medical students in Pakistan reported that the students used up to four medical apps and they did so more than once a day or at least once a day (25). Thus, medical students use their smartphones for most of their daily activities ranging from personal organiser, and social networking to academic study and professional practice. The use of other devices such as desktops or laptops is mainly supportive in fulfilling specific tasks such as doing a case write-up or report writing.

Factors associated with good clinical competency in our study are face-to-face teaching method, face-to-face precept method, and an integrated curriculum. The face-to-face method provides students with real-time experience in taking history, performing a physical examination, and managing patients. This practice serves as an important part of learning, hence achieving clinical competency. In a meta-analysis evaluating the effectiveness of online learning and clinical skills among undergraduate nursing students (26), six studies reported significant improvement in clinical skills following online learning, while the other six reported no significant difference. However, the meta-analyses were done for research purposes where only specific modules were delivered online without transforming all areas to online modules, in a pragmatic way like our study.

With regards to curriculum, students who experienced the integrated curriculum have better clinical competency compared to a fragmented curriculum. It shows that students were able to apply the theory that they received better when it was combined with their clinical practices. This combination of theoretical and clinical learning experiences allows students to acquire the knowledge, skills, and correct attitudes for their medical education (27). It is also emphasised that medical education needs to integrate the experience in the classrooms as well as in the clinics for the students to understand and be able to solve real clinical scenarios (28).

The strength of this study is, it compares the clinical competency and learning environment among students who received online and face-to-face teaching delivery. The study was conducted amid the COVID-19 pandemic, and the students were on movement control order by the government. Therefore, the setting of this study was done in a real-world situation rather than an ideal research setup. This study will also serve as a baseline study if we are to implement online teaching in the future. Furthermore, it provides a glimpse of students' clinical performance in whose medical degrees were affected by the COVID-19 pandemic.

The limitation of this study is it was done during COVID-19 without any comparison with the cohort prior to the pandemic. Furthermore, the sampling only involves primary care students in year 4. Future research involving students from other universities and other postings should be done to understand the factors that contribute towards a conducive learning environment.

CONCLUSION

Based on our findings, the COVID-19 pandemic has resulted in marked changes in the teaching and learning environment for our students. Face-to-face teaching is the preferred method as it was associated with good clinical competence and learning environment. The impact of experiential learning was huge in our study, and it cannot be replaced by online learning. There is an urgent need to evaluate our curriculum and module to ensure the students are receiving adequate training through online or hybrid methods. Retraining teachers is an important step to be taken to improve the online learning experience for students.

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