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Original Research

The online mock OSCE - a mixed-methods analysis of its benefits and overall student experience

ORIGINAL RESEARCH

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ABSTRACT

Background: A student-led Mock Objective Structured Clinical Examination (MOSCE) is a means of learning clinical skills which is shown to be beneficial to students. The social distancing requirements of the COVID-19 pandemic resulted in the inability to deliver a student-led face-to-face MOSCE. We investigated whether an online MOSCE would provide similar benefits.

Methods: We ran an online MOSCE for Year 2 undergraduate medical students at the University of East Anglia. We used a mixed-methods approach to evaluate the impact of the online MOSCE. We evaluated students' perceptions of the effectiveness of the online delivery compared to face-to-face delivery. We collected quantitative and qualitative data. We interpreted the data via paired sample t-tests and supplementary thematic analysis.

Results: 72 students took part in the online MOSCE. 43 students took part in the research. Comparison of anxiety scores pre-and-post-OSCE demonstrated a significant decrease towards a summative OSCE, in both similar and different stations. Students reported a significant rise in their confidence and retention of clinical skills due to the online MOSCE. Students' opinions of the online OSCE were positive. Students identified the provision of useful feedback on clinical skills, allowance of recognition of knowledge gaps, and enablement of increased familiarity with the assessment process as notable benefits from participation in the online MOSCE.

Discussion: The student-led online MOSCE represents an excellent alternative to face-to-face delivery; it is well-received by students and offers several benefits, including perceived decreased anxiety levels, increased confidence and improved self-reported retention of clinical skills, alongside logistical advantages of the online process. This study provides evidence of the advantages of the online MOSCE. The logistical advantages of the online MOSCE suggest that even as in-person training becomes feasible again in the post-COVID world, an online MOSCE is a viable alternative or addition for student educators to consider using in the undergraduate curriculum.

BACKGROUND

The OSCE is the main method of examining clinical skills of healthcare professionals and allows for the assessment of higher levels of medical competence. (1,2) Preventing skill decay is important in medicine, and frequent OSCEs have been shown to enable skill retention. (3,4,5,6) Logistical, financial and administrative difficulties make carrying out frequent OSCEs unfeasible. (7) The 'Mock OSCE' (MOSCE), is a formative assessment tool usually run by peer students, who enable junior students to practice key clinical skills on a smaller scale, without the need for the substantial resources necessary for a summative university-run OSCE. This allows for the 'deliberate practice' and 'testing effect' highlighted in the literature as important for retention, without the logistical issues. (3) Evidence shows MOSCEs to be well-received as a learning experience by participants. (8, 9, 10) Further studies report specific benefits offered by MOSCEs e.g., anxiety reduction. (11, 12) Evidence suggests anxiety has a negative impact on performance, meaning anxiety reduction has the potential to improve performance in an OSCE setting. (13, 14) MOSCEs can also increase confidence, (9, 10, 12) another factor that can be linked to improved attainment (15, 16), but more research is needed to confirm the benefits of participation in MOSCEs. (17)

Medical education has been greatly affected by the COVID-19 pandemic. Social distancing means delivery of OSCEs and MOSCEs has become a challenge. (18) Participant segregation and temperature checks need consideration; these make the delivery less feasible for medical schools. (18) Continuing effective medical education is of considerable importance, and 'novel ways of online teaching' have been developed in response to the pandemic. (19) The MOSCE, like other teaching modalities, needs to adapt to the demands of the current educational climate. A potential solution is a conversion to an online format; this has been successfully used in both clinical practice and consultation skills. (20, 21) Two studies that have focussed on the concept of an online MOSCE (22, 23) indicate that it is practicable and can have similar benefits to a face-to-face approach, but no work investigates the topic in detail. Therefore, this is an area into which further research is warranted. Our study assessed if an online approach to the delivery of a MOSCE can offer a suitable alternative to face-to-face delivery to inform ongoing practice.

METHODS

Research Plan and Aims

We designed and carried out a student-led online MOSCE (22, 23). We evaluated the online MOSCE compared to face-to-face MOSCE.

Through questionnaires, we investigated students' perceptions of:

- The impact of participating in the online MOSCE on skill retention
- The impact of the online MOSCE on anxiety levels
- The impact of the online MOSCE on confidence

We also explored the logistics of running an online MOSCE to guide further use of the method.

Construction and Execution of the online MOSCE

We designed an online MOSCE for Year 2 students at Norwich Medical School, University of East Anglia (UEA). We obtained consent from the course director and content guidance from the Head of Year 2. We emailed 140 students. 72 Year 2 students took part in the online MOSCE.

We ran the online MOSCE on 12th, 13th, 19th and 20th September 2020 using Microsoft Teams. Each student was interviewed by a single examiner (see Appendix A, Table 1). Examiners were Year 5 MBBS students at UEA. 15 examiners took part. Examiners arranged a video call via Microsoft Teams with one student at a time (considering the issues with having multiple students to one examiner highlighted by Kakadia et al. and used the screen share function to display the instructions. (23)

In data interpretation stations, examiners posed questions based on the material on the screen. In consultation skills stations, examiners acted as the patient, with screen sharing paused, to allow for simulation of a standard telemedicine consultation. Examination stations were conducted via the student talking through their process of patient examination; participants were given clinical findings that would have been encountered and were asked to present these and suggest further actions. Verbal feedback was provided after each station, as well as the participant's score.

Study Design

After completion of the online MOSCE students were given the opportunity to take part in a research project to evaluate the online MOSCE.

We used a mixed-methods approach to evaluate the impact of the online MOSCE. (24, 25) A mixed-methods study allows for the collection of more comprehensive data and can prevent over-reliance on quantitative interpretations, by allowing for 'grounding' of these using participant experiences. (26) This approach allows quantitative findings to be interpreted in context which is valuable for the individualised nature of education.

To recruit students to the study, we emailed students via an administrative assistant as a gatekeeper, with an invitation to take part. We sent an online questionnaire, with an individual link, to students who consented to take part. Responding was optional and the questionnaire was fully anonymous to prevent pressure being placed upon participants to respond in a certain manner, which could impede the validity of the results . All participants were sent the recruitment email 7 days after completion of the consent form, to allow sufficient time for a considered reflection on the MOSCE, and its impact on confidence and anxiety levels. We left the questionnaire open for 5 days. The questions included quantitative and qualitative 'longer response' sections to allow for elaboration. We

avoided Likert scales, a common method of data collection within questionnaires, as these have been shown to give the possibility for social desirability bias to affect answers .(27) A copy of the questionnaire is included in Appendix C.

We operationalised the phenomenon into components that were gradable:
• Knowledge of the steps involved in examination
• Knowledge of the practical techniques needed to carry out an examination
• Knowledge of the structure of approaching examination/data interpretation
• Knowledge of the structure and content required of information giving

The scores listed are scaled from 1-7, rather than from 1-10 as for anxiety and confidence due to limitations imposed by the survey software. This did not affect the interpretation of the results, as the effect size of the different outcome measures were not compared. We assessed anxiety by asking participants to quantify perceived levels before the MOSCE and then after completion, to allow for comparison . Self-assessment of anxiety is a standard method of assessment, though this can be subjective. (28) We divided this further into anxiety surrounding the testing of similar stations, and also testing different stations, to allow determination of whether there was a change in anxiety in general, rather than simply due to familiarity with a certain station type. Confidence was the final main outcome measure; we broke this down to be station-specific. We asked participants to grade their confidence both before and after the MOSCE to allow for an assessment of any change in levels.

Participant Recruitment and Data Analysis

72 students volunteered for and took part in the online MOSCE, across 12th, 13th, 19th, and 20th September 2020 . 43 questionnaire responses were collected.

We obtained ethical approval from the UEA Faculty of Medicine and Health Research Committee to involve students who took part in the MOSCE in research. We recruited participants via the delivery of an email to the entire Year 2 cohort via an administration assistant acting as a gatekeeper to prevent participation pressure from being placed on the students.

The method of data analysis differed based upon the outcome being studied. For the three quantitative outcomes, a paired sample t-test of pre-and-post-OSCE scores using SPSS statistical software was used to assess the impact of the online MOSCE. The Kolmogorov-Smirnov test confirmed that the differences between pre-and-post-OSCE scores were approximately normally distributed, validating the use of parametric testing (see Appendix B, Table 1).

We constructed a 90% confidence interval for the quantitative outcomes. Whilst this differs from the 95% interval traditionally used in medical research, studies have discussed the arbitrary nature of the interval selected (29), with a 90% interval also used in some drug product studies.(30) As the nature of the research was educational, and the aim was simply to give evidence about a method of teaching, a tighter interval was not as necessary as it may have been if the topic involved was more sensitive, such as health interventions. More importantly, a 95% or 99% confidence interval would necessitate a larger sample size to support this. With such a small population from which to sample (n = 72), a larger interval would require a significant proportion of this cohort to be involved. Obtaining a high proportion of respondents would represent a significant challenge, given evidence demonstrating poor response rates to email surveys. (31)

We analysed the qualitative responses using the well-studied approach of thematic analysis. (32) The data for each question was transcribed and then interpreted. As is discussed in the work of Creswell (33), an initial narrow unit of analysis was used to identify significant responses within each of the questions. The data for each question was then coded as a whole. Themes were drawn from the master code list and quotes that exemplified each were extracted.

So that the results of the quantitative analysis did not affect the coding process we analysed the qualitative results before the quantitative analysis was carried out.

RESULTS

44 responses to the questionnaire were received; 43 of these were from those who had taken part in the online MOSCE. The one remaining response was excluded from the analysis since the participant had not taken part. Of the 43 responses, 37 had previous experience with a face-to-face MOSCE, meaning that they could answer questions concerning the comparison of the experience. Insert (Figure 1)

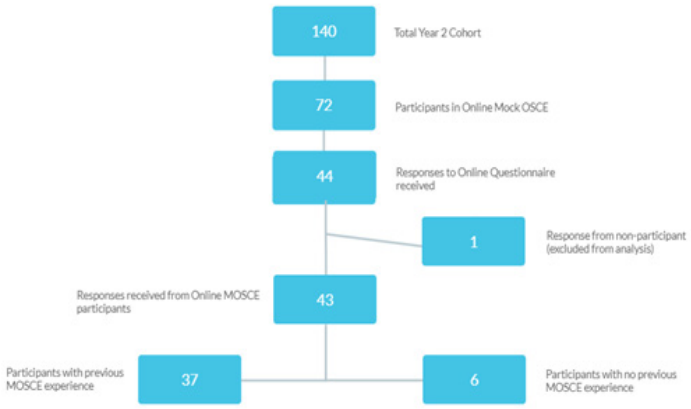

Figure 1: *Flowchart displaying participant recruitment numbers during the study*

Table 1:

Themes	Summary	Sample Response Quotes
Utility of the online MOSCE as a learning experience	Students found the ability to receive useful feedback immediately after stations useful to consolidate learning	*'It was really useful to work through the scenarios and receive 1 to 1 feedback'* (Mock OSCE Participant L2, Year 2)
	Participants believed that the MOSCE enabled the identification of knowledge gaps	*'(The online MOSCE) reminded me of what I did know, which was extremely useful'* (Mock OSCE Participant E1, Year 2)
Impairment of current environment for clinical skill delivery	Students consistently referenced that the online MOSCE was particularly useful given limitations to clinical skills exposure due to social distancing	*'The experience was invaluable given the COVID circumstances… it helped me to guide my revision and gave me confidence and reassurance'* (Mock OSCE Participant X2, Year 2)
Altered confidence levels	Students felt that confidence was often improved through participation. This was often linked with comments regarding familiarity with the OSCE process due to added exposure	*'the MOSCE really helped to build my confidence'* (Mock OSCE Participant D1, Year 2)
Increased comfort with OSCE process	Participants reported that the online MOSCE enabled greater comfort with the overall OSCE process. Links were often made to the senior students acting as examiners facilitating this comfort	'*a friendly environment where you are confident no one is judging you'* (Mock OSCE Participant L1, Year 2)
		'*I feel like the main thing is indeed building confidence, as that is vital in the actual exams… a MOSCE really helped to build confidence*' (Mock OSCE Participant X2, Year 2)
Examination station reality	Students acknowledged that the online format limited the examination experience	*'Examination stations are obviously difficult online, but still worth doing'* (Mock OSCE Participant L2, Year 2)
Pressure of online MOSCE	Participants frequently mentioned differences between the online and in-person environment	*'There was less stress, as I was doing it at home in a comfortable environment'* (Mock OSCE Participant P2, Year 2)
	Opinions on whether or not this was beneficial was mixed amongst students, although in most cases this was reported as a positive factor	*'It was an overall very open environment to make mistakes'* (Mock OSCE Participant F1, Year 2)

Table 2: *Results for Main Outcome Measures*

Outcome		Mean Pre-OSCE Score (SD**)	Mean Post-OSCE Score (SD**)	Percentage Change in Mean Score	Difference in Mean Score	Paired t-test statistic	P value	90% CI
Confidence								
	Communication Skills	6.02 (1.54)	7.40 (1.26)	22.9%	1.37	5.95	<0.001	(0.98, 1.76)
	Data Interpretation	5.81 (1.47)	7.32 (1.07)	26.0%	1.51	6.40	<0.001	(1.11, 1.91)
	Examination Station	6.02 (1.42)	7.23 (1.20)	20.1%	1.21	5.93	<0.001	(0.87, 1.55)
	Overall	5.95 (1.06)	7.32 (0.81)	23.0%	1.37	7.74	<0.001	(1.07, 1.66)
Anxiety								
	Regarding Similar Stations	7.81 (1.75)	5.14 (1.86)	-34.2%	-2.67	9.49	<0.001	(2.2, 3.15)
	Regarding Different Stations	7.81 (1.75)	6.30 (1.71)	-19.3%	-1.51	5.53	<0.001	(1.05, 1.97)
Retention⋆		4.88 (0.99)	5.68 (0.82)	16.4%	0.80	8.01	<0.001	(0.64, 0.97)

A mean score of 8.86/10 was reported by the students when asked to rate the overall learning experience of the online MOSCE (see Appendix B, Table 2). Individual written responses gave a similar impression to this high mean score. The utility of the online MOSCE for learning was a key theme identified during the analysis. Participants' justification of the positive utility varied, but several trends were identified. Summaries of this and the other main themes identified are displayed in Table 1.

The quantitative results for the study are displayed in Table 2.

The main outcome measures for confidence, anxiety and skill retention showed significant trends. The mean confidence levels and standard deviations for each of the 3 sections pre-OSCE were similar. The post-OSCE scores all showed a statistically significant increase. Data interpretation stations demonstrated the greatest mean percentage increase in confidence, with communication skills and examination stations showing slightly smaller increases . The mean confidence for each student across all 3 stations post-OSCE (mean 7.32, SD 0.81) represented a significant percentage increase of 23% from the mean pre-OSCE score across the stations (mean 5.95, SD 1.06) - the t statistic was calculated at 7.74, with a p-value ≤0.01 and 90% CI (1.07, 1.66).

The results showed a statistically significant decrease in perceived anxiety levels from pre-OSCE to post-OSCE with regards to similar stations being tested. The mean anxiety level post-OSCE for different stations being tested (mean 6.30, SD 1.71) was also lower than that recorded pre-OSCE.

The results for both anxiety and confidence correspond with key themes. Students reported a statistically significant increase in each of the operationalised measures used to represent retention of the skills involved in the MOSCE. 41 responses were used in the analysis (2 were excluded due to incompleteness).

DISCUSSION

The data show that comparison of anxiety scores pre-and-post-OSCE demonstrated a significant decrease towards their summative OSCE, in both similar and different stations. Students reported a significant rise in their confidence and retention of clinical skills due to the online MOSCE. Students' opinions of the online MOSCE were positive. The provision of useful feedback on clinical skills, allowance of recognition of knowledge gaps, and enablement of increased familiarity with the assessment process were some of the notable themes identified by qualitative analysis.

The data allowed for adequate assessment of the outcomes being studied. The number of responses (59.7% of those who took part in the MOSCE) was higher than expected given the method of delivery when considering research detailing the average response levels. When considered alongside the positive outlook portrayed by the students, this indicates that participants felt motivated to be involved in the research and gives a degree of reinforcement to the results. The 43 responses involved in the analysis represent a similar figure to the majority of the other key works on the topic. It is an equivalent level of involvement to the work of Robinson et al (n= 54 students) and that of Lee et al (n= 42 students), who both provided important evidence on the topic.(8, 12)

The response to the learning experience of the online MOSCE was overwhelmingly positive; the mean score was extremely high with no student giving a score of less than 7. This result implies that, at the very least, the majority of students found the online MOSCE useful for their learning. This quantitative result was supported by the qualitative aspect of the survey, responses were in-depth, again highlighting the motivation of the students. The longer-answer parts of the questionnaire were not compulsory for questionnaire completion; therefore, the substantial amount of qualitative data collected demonstrates that participants were willing to take time to respond, reducing any argument for factors such as acquiescence bias impacting results.

Given research that portrays the MOSCE as an excellent learning experience, and similar to that of the in-person OSCE, the mean score for the online MOSCE gives validation of the method as an alternative for delivery. The student comparison of the online format to an in-person delivery also supports this conclusion. The mode score of 5 implies that most students found the online MOSCE a similar replacement to the traditional version, with the fact that the mean score exceeds 5 suggesting that on average, the students found the format more beneficial. The qualitative responses are therefore of particular importance as they give an insight into students' justification of the score. The main advantages were centred around the logistical benefits of the online process; the mean of 5.97 gives evidence to suggest that these at least mitigate any drawbacks of the approach.

One of the most noteworthy themes identified was that the online method was associated with a reduction in the pressure of the experience. This is important as it was referenced by some students as a benefit, but also as a negative by others. Responses included that the lack of pressure may '…not necessarily be an advantage' for learning and that performing the skills is '…not the same as doing it under pressure' (Mock OSCE Participant J2, Year 2)). The concept of deliberate practice and the 'testing effect' are both important for retention and formal examination remains a beneficial method of mediating this. (3) The reduced pressure of the MOSCE reported by some students may therefore affect the degree to which retention is enhanced. It is plausible that this observation of reduced pressure has links to the peer-run nature of the OSCE, as well as logistical factors such as engaging with the MOSCE from home. Several students referred to the peer-assessed nature of the MOSCE as being less intimidating. These findings highlight a need to balance optimum learning conditions for retention with a relaxed environment to promote full student engagement. This is not a concept that has previously been considered in relation to MOSCEs and is an area worth exploring further. For example, the gap in terms of educational experience between assessors and par-

ticipants (2 years in this study) may influence the environment of a MOSCE, given research into the concept of 'social congruence'. It would be feasible to carry out studies involving peer-students of differing levels of seniority to participants, to assess the effects of this.

The results collected for confidence and anxiety demonstrated statistically significant differences in levels reported post-OSCE. The findings correlate with those of other studies investigating the topic. Robinson et al assessed confidence in a similar way to this study, reporting comparable results of a mean increase of confidence (scaled from 1 to 10) of 1.41. (12) The authors acknowledged that the 'modest sample size' was a limitation; however, with this study involving a similar population and producing almost identical results, such repeatability increases the faith that can be placed upon the findings. An improvement in confidence was one of the key themes identified during qualitative analysis, with multiple students referring to this when asked to describe perceived benefits of the Online Mock OSCE. Whilst changes in confidence were directly asked about in the questionnaire, which could account for the identification of this theme, questions about confidence came after the long-answer questions, making this less likely.

The fact that examination stations scored lower in terms of improvements in confidence and anxiety was expected, given the limitations of having to examine patients online. This remains an ongoing issue for any online MOSCE and represents a major challenge given the limitations to contact at the current time. A noteworthy point is that procedural skills will face the same, if not increased problems with online delivery. Whilst these were not tested in this version of the online MOSCE, they remain a crucial part of the outcomes expected of those graduating with a medical degree, and challenges with incorporating these stations into an online format must be acknowledged; assessing procedural skills is unlikely to ever be an area to which the online MOSCE is well suited.

In keeping with the other outcome measures, the results demonstrated increases for perceived retention in all sections, including those for the examination stations. Thus, despite the drawbacks and the identification of this as a theme from the longer written responses, it appears that students still found these stations beneficial for their learning. This is supported by excerpts from the qualitative data:
'…talking through [examination stations] was still a valuable learning experience' (Mock OSCE Participant G1, Year 2)
'I did gain some benefits from explaining how I would complete the examinations' (Mock OSCE Participant A2, Year 2)
Based on the results of this study, it is plausible to conclude that in the view of the students involved in the online MOSCE, the intervention offers a similar experience to an in-person MOSCE. Most importantly, the process is valued as extremely useful for learning, as evidenced by the students' quantification of the learning experience, and the qualitative responses. Of the 43 responses, 39 labelled the online MOSCE as a positive experience.
This demonstrated similarity extends to other benefits of face-to-face MOSCE participation. The online MOSCE allows for an increase in student confidence and a decrease in anxiety, and there is evidence to support the hypothesis that it improves retention of key clinical skills. The findings build upon those of Young et al, Bevan et al, and Robinson et al, providing further power to the argument supporting the inclusion of the method in the medical curriculum. (9, 10, 12) The MOSCE offers immediate assets to students, considering the results for the main outcome measures, but also, given the literature supporting the importance of the repeated testing of skills to maximise long-term retention and prevent skill decay, the possibility of more deep-rooted benefits in terms of continuing clinical competency.

As well as the assets of the intervention making it an option for delivering learning in its own right, two of the written responses referred to the possibility of combining an online MOSCE testing solely data interpretation and communication skills with in-person clinical sessions focussing on examination and practical skills. The findings of the research would certainly support further consideration of the MOSCE as an approach to a form of 'blended learning '. This format has been shown to deliver better effects on knowledge retention in comparison to traditional methods. (34) The teaching method has been studied directly in medical students and has been shown to increase both satisfaction and engagement with studies. (35) The online MOSCE should, therefore, not be regarded as simply being a 'flash in the pan' that is only considered in the context of the current pandemic. An online MOSCE certainly has attributes that give it utility in any form of educational curriculum, especially given its suitability to be included as a form of blended learning; an educational approach with several strengths, that is being increasingly used in the medical curriculum.

As our study represents one of the first into the topic of an online MOSCE, it is important to reflect on the process and potential areas for improvement. This will allow our work to provide a 'toolbox' for others to build upon in constructing online Mock OSCEs in the future. Our online MOSCE delivery and research methods can be replicated and perfected by others to give further evidence for continued use within medical education. Ways in which our MOSCE could have been beneficially adjusted may include having a 'simulated patient' alongside an examiner to make assessing this station more straightforward. It should be acknowledged that this would have been accompanied by an increased risk of technological difficulties, with 3 individuals accessing an online room, rather than a standard video call format. Another possibility proposed by an individual who completed the longer written feedback would be to have students complete the online MOSCE in pairs.
'An online OSCE could be carried out with participants in pairs, to allow them to examine each other under the supervision of the examiner' (Mock OSCE Participant E, Year 2)
This would allow for one to examine the other, potentially adding increased realism and validity to this station, which is less suited to online delivery. We encourage anyone planning an online MOSCE to consider these adaptations and reflect on their impact.
The research is not without its limitations. The self-reported nature of the data collected, in combination with the peer-assessed nature of the MOSCE (participants may be more obliged to answer in a way to appease those involved in running the session) give the potential for response biases to impact the results. In addition, as the data was interpreted by only a sole author due to the small nature of

the intervention, there was no opportunity to cross-reference codes or themes with others. Qualitative interpretation must always be considered with the perspective of the researcher in mind.

An illustrated example of this would be the interpretation of one of the comments of Participant G2:
'It was great to have 1-1 help and guidance. The OCE (sic) was a totally no pressure exercise.'
Considering that the comment on the pressure of the MOSCE followed a positive statement, this was coded as giving a positive perception of the low, pressure. However, other interpreters may not consider this quote sufficient to give evidence either for or against whether the low pressure of the experience was beneficial, as the student does not explicitly expand on this. The knowledge of existing themes may have had an impact on how this statement and other similar examples were coded.

Given the anonymity of the questionnaire, respondent validation to confirm the interpretation of such responses was not possible. This step would have enhanced the trustworthiness of the conclusions drawn. (36) Nevertheless, given the correlation with the quantitative results, the similarity of the findings to those of Robinson et al (12) and much of the other literature on MOSCEs, as well as the in-depth nature of responses; it is hoped that the results of the study represent a good reflection of students' perception of the online MOSCE.

The method used to collect data on outcomes pre-and-post-OSCE is another area in which bias had the potential to impact the conclusions drawn. Students were asked to report both sets of scores in the questionnaire having already taken part in the MOSCE, rather than being asked to do so before completion, and then again after participating to allow comparison. The reasoning behind this was the fact that students were not approached to be part of the research until after the MOSCE; a restriction placed upon the research by the faculty members at the university, to ensure the online MOSCE was a learning experience open for all.

Despite this justification, quantifying pre-OSCE scores after the event opens the door for 'response shift bias', defined as 'program-produced changes in the participants' understanding of the construct being measured'.(37) Students may not accurately remember their anxiety level from before the MOSCE, and their recall may be influenced by their participation. However, the overall trend was the main focus when analysing the results, and a non-standardised starting score on an arbitrary scale of 1 to 10 is of less relevance than the overall increase or decrease in score post-OSCE. 7 days were waited for questionnaire distribution, to allow time for students to reflect upon the impact of the MOSCE, for the greatest chance for students to accurately determine the effect of the intervention on anxiety, confidence and retention, as well as their perceptions on the process. The likelihood of this design flaw impacting the results significantly is reduced by both the supporting qualitative responses for a decrease in anxiety, and increase in confidence and the close relation between the results of this study others investigating the subject.

Ideally, skill retention would have been tested objectively by methods such as direct repetition of stations in the form of an unannounced test, to determine any improvements due to the MOSCE. However, this posed issues given the busy nature of the medical curriculum, adding additional testing into the schedule of students could have caused unnecessary stress amongst participants. The prospect of an unannounced test also had the potential to deter individuals from volunteering to be part of the research, reducing the number involved and the strength of any findings obtained. Therefore, simple self-reported perceptions of retention were used to assess this outcome.

The results also highlight avenues within which further study may expand existing knowledge about the MOSCE. As previously discussed, there is evidence to support the exploration of the relationship between MOSCE participation and summative performance. Should MOSCEs be found to offer an objective benefit in terms of improved student scores or pass rates, the power of the teaching method would be asserted. The research also identifies the need to consider some of the drawbacks of a peer-student-based approach; scrutinizing the impact formality has on the potential for skill retention. Investigation of the extent to which the method of assessment can reduce the formality of the experience and compromise the 'testing effect' is worthwhile as this would potentially offer insights into drawbacks of the use of peer students not previously discussed in the literature. This may have ramifications for the Online MOSCE, the environment for which may already contribute to a reduced pressure setting.

This work provides evidence for the positive influence of the Online MOSCE on anxiety, confidence, and the retention of clinical skills amongst undergraduate medical students as well as adding to the existing knowledge base on the usefulness of a MOSCE. The small sample size and self-reported nature of quantitative outcome measures make conclusions drawn from them limited. However, there is significant concordance with the qualitative data collected, strengthening the inferences drawn. The frequently utilised, albeit sometimes criticised Kirkpatrick model (38, 39) depicts that whilst 'results' may represent the highest hierarchical level of evidence when analysing teaching interventions, student reaction and areas of learning are also essential to consider. This is particularly the case in small-scale interventions such as a MOSCE. The qualitative data provide valuable information on the student perception of a new method of educational delivery and offers detailed insights into several participant-reported benefits, with quantitative data supplementing this.

The online method of MOSCE delivery, devised in response to limitations of in-person teaching represents an ongoing option for the medical curriculum. This is the first study to explore the approach in depth and offer insights into the potential of an Online MOSCE as a feasible and practical addition to, or replacement of, a face to face version. This study gives validation of its adoption in medical schools. The opportunities for learning and practical advantages of the Online MOSCE provide a powerful component to add to the toolbox of the medical educator.

APPENDIX A: MOCK OSCE STRUCTURE

Table 1: *Mock OSCE Structure*

Station No.	Content	Time Allocated
1 (a, b)	(a) Examination of the Cardio-Respiratory System (b) Respiratory Data Interpretation	10 mins
2	Dermatology Data Interpretation	5 mins
3	Consultation Skills - Informative Giving Scenario	10 mins
4	Lymphoreticular Examination	5 mins
5 (a, b)	(a) Focussed Chest Pain History (b) Cardiac Data Interpretation	10 mins
6	Knee Examination	5 mins
7	Joint Pain Data Interpretation	5 mins

APPENDIX B: QUANTITATIVE JUSTIFICATION AND RAW DATA

Table 1: *Kolmogorov-Smirnov Analysis*

Data Set	KS Statistic	P value	Interpretation
Pre-OSCE Anxiety and Post-OSCE Anxiety same stations	.11952	.51761	No evidence to reject null hypothesis implying normal distribution
Pre-OSCE Anxiety and Post-OSCE Anxiety Different Stations	.15207	.23584	No evidence to reject null hypothesis implying normal distribution
Consultation Skills	.15703	.21574	No evidence to reject null hypothesis implying normal distribution
Data Interpretation	.20735	.06001	No evidence to reject null hypothesis implying normal distribution
Examination	.19082	.07611	No evidence to reject null hypothesis implying normal distribution
Average Retention Pre-OSCE and Average Retention Post OSCE	.13027	.42315	No evidence to reject null hypothesis implying normal distribution

Table 1: *Overall Learning Experience - Score Frequency*

Student Overall Learning Experience	Frequency
0-6	0
7	6
8	7
9	16
10	14

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