Original Article

Effect on exam performance through massive open online courses versus face-to-face classrooms among Indian medical students: An analytic study

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Abstract

Background & Objective: With the affluence of use and better accessibility, Massive Open Online Courses (MOOCs) have become essential in imparting education in the ongoing COVID scenario. The study aims to compare the effect of MOOCs versus face-to-face classrooms on medical students' learning outcomes in anatomy exams at the end of the first year of a medical course.

Materials & Methods: The cross-sectional study included 300 first-year Bachelor of Medicine and Bachelor of Surgery (MBBS) students in two batches (150 each). The first group underwent a one-year MOOCs group, and the second group experienced a one-year face-to-face classroom. The training program and study materials for the anatomy curriculum were kept the same for both groups by the standard National Medical Council curriculum of India. The assessment was standardized and based on summative University examinations.

Results: The mean score in the university theoretical exam was significantly higher in the MOOCs group as compared to the classroom learning group (66.68 ± 6.61 vs 63.52 ± 7.97, P-value: 0.001), whereas the mean scores in the practical examination were significantly higher in classroom learning group as compared to MOOCs group (78.71 ± 6.28 vs. 74.19 ± 7.45, P-value: 0.001). The MOOCs group shows better learning in the cognitive domain.

Conclusion: The classroom learning groups performed better in the practical examination, which assesses the psychomotor and affective domain of learning. Hence, a blended T/L method involving both classroom and online methods is recommended as India's preferred approach to imparting medical education.

Keywords: Massive Open Online Courses, Anatomy, Blended Learning

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Introduction

Medical education not only helps undergraduates acquire knowledge but also skills that help them to take care of the health care needs of society (1). The medical education program focuses on addressing the cognitive, psychomotor as well affective domain of the students (2). Classroom teaching has been the recognized approach to impart medical education. Multiple methods and strategies are used in classroom teaching such as teacher-controlled classroom teaching where the teacher at its center is a single authority (autocratic/ monologue teaching), Interactive teaching which includes group discussion, tutorials (dialogue teaching), clinical teaching methods, question-answer sessions, practical sessions in laboratories, patient exposure, symposiums, regular assignments, etc. Student-centered approaches like Early clinical exposure (ECE), Self-directed

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learning (SDL), Computer-assisted teaching and instructions, and workshops on clinical emergencies have certainly raised student involvement, which has been also made mandatory by the National Medical Council (NMC) (3).

During the COVID–19 scenario in which classroom learning was not available for students, the quest for better teaching-learning (T/L) techniques was in progress (4). The introduction of Massive Open Online Courses (MOOCs) methods at the undergraduate level of medical education has opened a new horizon of teaching strategies. It makes learning more convenient and accessible (5). The MOOCs method was provided in a platform where a teacher can share the recommended study materials. It has unlocked limitless prospects to make a dry difficult concept interesting through videos and other multimedia. Applications like WhatsApp, Telegram, Un-Academy, and platforms like Coursera, Edx and Sandeepgyan are commonly used in Massive Open Online Courses (MOOCs). A MOOCs is a free web-based distance learning program that is designed for large numbers of geographically dispersed students. A MOOC may be patterned on a college or university course or be less structured, can be helpful in group discussions around the clock where a teacher can guide the students to avoid the formal environment of traditional classrooms (6). In India, mid-march 2020 witnessed a nationwide lockdown due to the COVID-19 pandemic. Students were sent home in the mid-session and classroom teaching came to an abrupt stop. For the second half of the session, traditional classroom teaching methods were replaced by internet-based teaching methods, thus, for the next 5 months' students were taught by online teaching methods (5,7). This gave us a perspective to compare traditional classroom learning (CL) methods with MOOCs methods for 1st year of Bachelor of Medicine and Bachelor of Surgery (MBBS). Since a teaching curriculum should evaluate the student's cognitive domain, including remembering, understanding, applying, analyzing, evaluating, and creating new ideas; the affective domain, which is related to motivation and attitude and lastly, the psychomotor domain (5,6,7); this is the only study till now for such a comparison in India. It is an attempt to observe the impact of these two methods of learning on learning outcomes in anatomy at I MBBS level.

This study aims to compare the effectiveness of MOOCs and CL methods by assessing the learning outcomes in all domains of learning, viz., Cognitive, psychomotor, and affective.

Materials & Methods

Design and setting(s)

The study is a cross-sectional study conducted in the Department of Anatomy in a medical college in western Maharashtra, India.

Participants and sampling

Three hundred (150 per batch) 1st-year medical students of two consecutive years that are students of batches 2019 and 2020 were included in study. The sample size was calculated after consulting the statistician(95% confidence, and a margin of error of 5%. and population proportion of 30%) One hundred and fifty student in the CL group and 150 in the MOOCs group included in the study by random sampling after informed consent. The students who did not attend 80% in the first year of the medical courses were excluded from the study. As per NMC guidelines, 80% attendance is mandatory for both theory and practical to appear in university exams. Hence, the exclusion criteria were students having less than 80% attendance. However, all the students were above 80% of attendance. The study period was two years. The students of the 2019 batch attended the classes through the traditional classroom method in which they had a face–to–face interaction with the teacher, and students of the 2020 batch participated in the classes through the MOOCs platform. The study observed the mean score of the students of both batches in various domains of the university examination, including theoretical and practical. Overall performance was noted, which helped us to compare the advantages and disadvantages of both MOOCs and CL methods.

Data collection method

Classroom learning and MOOCs were the two groups based on the mode of teaching methods adopted for teaching anatomy during the second term of the first year of the medical course. The CL group underwent traditional classroom teaching in 2019, with attendant classes. They have also done dissection during their practice time for 1st time during one year. The MOOCs group underwent online course for five months in 2020 on the MOOCs (www.Sandeepgyan.in/) platform. The students were given user IDs and passwords to log into this recognized platform. They could attend live lectures, and access pre-recorded dissection videos during practice time. This period was followed by one month of classroom learning in which the teachers briefly taught the topic's gist and showed them already dissected specimens before the final examinations. The training

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program and study materials for the anatomy curriculum were kept the same for both groups, following in the standard NMC curriculum of India.

Both groups were assessed in the standard Anatomy University Examination by standard examination procedure, which involved a theoretical examination followed by a practical examination. The data collection has also been explained in Table 1.

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Table 1. Data collection methods

S.NO.	Data collected	Source	Cofounders
1	Final university examination mean score of the students of batches 2019 and 2020	Departmental records stored in computer database	Nil

Tools/Instruments

The standard marking scheme of the anatomy university examination is shown in Table 2. The multiple choice questions (MCQs) carry one mark each in which the students have to correct the right answer. The long answer questions carry ten marks each; the short answer question carries five marks each, and the brief answer question in which the students have to write one-line answers, carry one mark each. The students have to write according to the marks of the questions.

In the grand viva, the students are asked to answer various questions orally from every aspect of the subject. In grand viva, the students are asked 10 questions carrying 5 marks each including Embryology, Osteology, Gross Anatomy, Genetics, and clinical anatomy which carry the maximum weightage of marks in the practical examination, that is 50 marks. In case of spotting, the students have to identify the histological slides focussed under the microscope in one minute given for each slide. The students must identify ten slides carrying two marks each. Further, in the spotting section, the students have to identify ten different dissection instruments carrying one mark and given one minute time for each instrument and mounted specimen, each carrying one mark and given one minute time. In total, the spotting section carries 30 marks. Lastly, students are given two clinical case scenarios carrying ten marks each with a time limit of two minutes for each case, in which they are shown a case history of the patient on a sheet of paper. The students have to make a diagnosis based on the patient's history, and accordingly, the examiners ask the questions, and students are evaluated.

Table 2. The standard marking scheme of the anatomy university examination

Theoretical examination					
Learning domain	**Type of tests**	**Number of questions**	**Maximum marks**	**Total mark**	**Minimum pass level**
Cognitive	**MCQs** [1]	20	20	100	50
	LAQs [2]	2	20		
	SAQs [3]	8	40		
	BAQs [4]	20	20		
Practical examination					
Psychomotor and affective	**Grand viva**	10 Each question carries 5 marks	50	100	50
	Spotting	Histology 10 spots. Each spot carries 2 marks. Dissection instruments 10. Each carries one mark	30		
	Clinical case evaluation	2	20		

1- Multiple choice questions
2- Long answer questions
3- Short answer questions
4- Brief answer questions

Data analysis

The Data followed a normal distribution and was analyzed by independent sample T-test for intergroup comparison. The p-value < 0.05 was considered significant. Data analysis was done in SPSS version 20.

Results

300 (150 per batch) 1st-year medical students of two consecutive years, that is, students of batches 2019 and 2020 between the age group 18-21 years, 234 boys and

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66 girls, of similar socioeconomic status were included in the study: 150 in the CL group and 150 in the MOOCs group (Table 3). In the Final University theoretical examinations, the MOOCs group scored 66.68 ± 6.61, significantly better marks (P-value: 0.001) than the CL group with 63.52 ± 7.97 marks. In the University practical exams, the CL group scored significantly higher marks, 78.71 ± 6.28 (P-value: 0.001), compared to the MOOCs group (74.19 ± 7.45). The total percentage of marks at university exams of the MOOCs group (69.28 ± 5.19) was marginally better than the CL group (68.91 ± 5.90), though not statistically significant (P-value: 0.565) (Table 4).

Table 3. General characteristics of both the groups

S.No.	Parameter	MOOCs Group (n=150)	Classroom learning (CL) group (n=150)
1	Age	18-21 y	18-21 y
2	Gender	Boys 117	Boys 117
3	Education status	Girls 33	Girls 33
4	Health status	Medical Undergraduates	Medical Undergraduates

Table 4. MOOCs versus Classroom learning final university examination marks comparison

Exam	Sample: (N)	MOOCs Group	Classroom learning (CL) Group	P-value*
Theoretical	150	66.68±6.61	63.52±7.97	0.001**
Practical	150	74.19±7.45	78.71±6.28	0.001**
Overall	150	69.28±5.19	68.91±5.90	0.565

*P.value calculated by independent sample T-test for intergroup comparisonss
**Significant P.value

Discussion

In this study, the theory exam included MCQs, BAQs, SAQs, and LAQs which evaluated the lower levels of learning, i.e., remembering, understanding, and applying, and clinically based questions assessed higher levels of cognitive learning, i.e., analyzing, evaluating, and creating. In our study, the MOOCs group scored 66.68 ± 6.61 significantly better marks (P-value: 0.001) as compared to the classroom learning group with 63.52 ± 7.97 marks. In the University practical exams, the classroom learning group scored significantly higher marks, 78.71 ± 6.28 (P-value: 0.001) than the MOOCs group (74.19 ± 7.45). The total percentage of marks at university exams of the MOOCs group (69.28 ± 5.19) was marginally better than the classroom learning group (68.91 ± 5.90), though not statistically significant (P-value: 0.565). The psychomotor domain has been categorized by Harrow's taxonomy (11) into reflex movements, fundamental movements, perceptual abilities, physical abilities, skilled movements, and non-discursive communication. The affective domain of learning was categorized by Krathwohl's taxonomy (12) into receiving, responding, valuing, organization, and characterization. Learning outcomes of both these domains were assessed by the practical examination, wherein face-to-face interactions with students enables the assessment of the affective and psychomotor domain. The MOOCs group scored fewer marks in practical exams which, points towards the inability of MOOCs to give sufficient time to learn clinical skills and inculcate behavioral change. Hence, we found that MOOCs was effective in gaining knowledge, while classroom learning was better for learning skills and professional behavior.

Our results were similar to a study conducted on 80 nursing students who were divided into two groups of 40 students each. The first group underwent MOOCs while the other group had traditional classroom learning. The final exam results and self-administered Questionnaire was used for assessment. They found that the marks obtained by the MOOCs group were significantly higher (P-value: 0.002) than the traditional classroom learning group. This study was conducted in Jan-Aug 2019 at Najran University, Saudi Arabia (13). The results found that the mean scores obtained by students in the final exam by the E-learning group (Experimental) are statistically significantly higher than those for the traditional classroom group (controls).

Subramanian et al. (14), in their study using step stone interactive medical software on 30 third-year medical students, reported better long-term retention in the online teaching group compared to classroom teaching, indicating better learning in the cognitive domain and retention of facts in online learning. Mitchell et al. (15) did a questionnaire-based study on undergraduate nursing students. They reported that students with frequent access to online educational content obtained higher scores in the theoretical examination.

In an Iranian study on the comparison of online and traditional learning, 39 dental students (16) were divided into online (20 students) and traditional (19 students) learning groups and matched on their Grade point

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average (GPA). These groups received 6 hours of learning sessions by the same mentor, followed by a theoretical test with multiple choice questions and an objective structured clinical examination (OSCE). They found significantly higher scores in the online group in the theoretical exams and no significant difference in scores in clinical exams. The possible reason for an insignificant increase in scores of clinical exams may be only 6 hours of intervention.

Cooper and Higgins (17), in a study on 98 students, have recommended using electronic media within Classroom teaching to improve psychomotor and clinical skills in the students. Thus, blending online teaching methods with classroom teaching methods is required. With the technology improvement in the future, the online teaching method will be more comprehensive, and the effectiveness of blended learning can be increased to provide more understanding of the student to students.

Limitations

There are a few limitations of the study. The assessment was based on total marks in theoretical and practical examination, and break up for MCQs, BAQ, SAQ, LAQ, and clinical based questions were not available separately. The individual analysis of learning outcomes in the cognitive, psychomotor, and affective domains could have been done better with a break-up of the total marks in theoretical and practical exams. We did not follow any tailor-made blended model for medical education. Thus, further longitudinal studies are required to formulate an appropriately blended learning program for medical undergraduates and ascertain the learning outcomes of this program. Another limitation is about the study design, which determines cause-effect interpretation from a cross-sectional study. In addition, this study was conducted only on First Year MBBS students and cannot be extrapolated to the rest of the MBBS course.

Conclusion

The MOOCs group shows better learning in the cognitive domain. In practical examination, which assesses clinical and soft skills that are the psychomotor and affective domains of learning, respectively, the classroom learning group was better. Hence, the blended teaching method, which combines classroom learning with MOOCs in medical education, is proposed to be the best holistic approach in India.

Ethical considerations

No ethical issues.

Ethical clearance no. IEC/2022/140

Name of the ethical committee: Institutional Ethical Committee, Armed Forces Medical College Pune.

Disclosure statement

No conflicts to declare.

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