

Evaluation of online active learning strategies in first year medical students

PADMAJA DARA, RAMADEVI MOPURI, SUJATHARANI A.

ABSTRACT

Background. Didactic lectures form a large part of the teaching–learning process in medical education. To impart competency-based medical education (CBME) in the Covid-19 pandemic there was a shift to online learning. This pedagogical change would likely impact the efficacy of student learning outcomes. Several studies have shown that learning outcomes and knowledge retention increase considerably when lectures are interactive. However, the efficacy of online teaching with active learning strategies has not been studied.

Methods. At the Department of Biochemistry, Osmania Medical College, Hyderabad, we did this study with 203 first year MBBS students. Five sessions were conducted on the topic of ‘Enzymology’ with appropriate active learning methods. Each lecture session was preceded and followed by a test, which included multiple-choice questions (MCQs) and brief note questions (BNQs). Feedback of students, was recorded on the 5-point Likert scale from strongly agree to strongly disagree.

Results. The majority of students felt that answering questions in the pre-test required substantial effort compared to the post-test. The case scenarios included in the pre-test had a positive impact on the curiosity of students. The activities as part of self-directed learning were interesting, and enhanced understanding and retention. They felt lectures without pre-and post-tests were less efficacious and thus should be continued in all the classes.

Conclusion. Online lectures without pre-and post-test model were less efficacious. Online teaching, coupled with active learning increased interest and the understanding capacity of students.

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INTRODUCTION

Didactic lectures form a large part of the teaching–learning process in medical education as an efficient and standardized way to deliver information. During the Covid-19 pandemic, most educational institutions opted for online education rather than traditional modes of education. This coincided with the recently introduced ‘competency-based medical education’ in India. This poses a new challenge for the institutions, the instructors/teachers and the students as they must adapt quickly to the new mode of teaching–learning.

Understanding concepts in biochemistry is important for studying clinical sciences. However, many medical students feel that it does not have any clinical relevance since the first

year of medical teaching does not include patient-based teaching. The broad goal of teaching biochemistry to undergraduate students is to make them understand the scientific basis of life processes at the molecular level and to orient them towards its application in solving clinical problems.¹ It is important that students with help from the instructor confront their misconceptions to promote more effective learning.

Didactic teaching is a teacher-centred passive learning environment. It requires excellent note-taking ability, auditory skills and a high working memory capacity for students. However, attention span studies have shown that students’ attention decreases considerably after 20 minutes in traditional lectures.² Moreover, first year MBBS students are often heterogeneous in their language ability, medium of instruction, learning styles, prior knowledge, socioeconomic and rural or urban backgrounds. Therefore, it is challenging both for students and instructors.

Interactive teaching–learning (ITL) involves an increased interchange between teachers, students and the content. The active learning process is student-centred and places the responsibility of learning on learners by not only listening but also thinking and doing things.³

Rao and Di Carlo compared traditional teaching with active learning groups, and concluded that active involvement of the students in the learning process enhanced their academic performance.⁴ Several studies on comparing the effectiveness of didactic lectures with those of interactive teaching styles have shown that student satisfaction, learning outcomes, deeper approach to learning, and knowledge retention are better after interactive lectures.⁵ It is still unknown whether online lectures with active learning strategies have similar outcomes in medical students.

We evaluated the efficacy and student perceptions on assessments and case-based scenarios as active learning strategies for online lectures in biochemistry.

METHODS

We did an online observational study including 203 of 250 first year MBBS students of Osmania Medical College, Hyderabad, Telangana, between March and April 2021, after obtaining approval from the Institutional Ethics Committee.

Oral consent was taken from students after explaining to them about the study and methods of intervention. A series of 5 lectures with a gap of 1 week on a topic of ‘Enzymology’ covering ‘Key concepts’ were conducted. Pre- and post-assessments were done in the form of MCQs and BNQs one day before the lecture and on the day following the lecture with case-based scenarios and other appropriate active learning methods, respectively. At the end of 5 lectures, feedback was recorded on a proforma containing 12 items on the 5-point Likert scale (Table I).

Students who had attended all 5 lectures and participated in the related activities were included. While those who did not give consent, had not taken assessment tests, nor attended the class, and gave no or incomplete feedback were excluded.

RESULTS

The majority of students felt that answering questions in the

Osmania Medical College, Koti, Hyderabad 500095, Telangana, India
PADMAJA DARA, RAMADEVI MOPURI, SUJATHARANI A.
Department of Biochemistry

Correspondence to PADMAJA DARA; drpadmaja.biochem@yahoo.com

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TABLE I. Student feedback

Question	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)
1. Is the time sufficient to study the topic-related information before the online class?	2 (1)	22 (11)	52 (25)	99 (49)	28 (14)
2. Multiple choice questions given in the pre-assessment are difficult to attempt	7 (3)	46 (23)	101 (50)	47 (23)	2 (1)
3. Brief note questions are difficult to attempt	13 (6)	71 (35)	76 (38)	41 (20)	2 (1)
4. Are case scenarios related to the topic creating enthusiasm in you?	44 (22)	118 (58)	31 (15)	10 (5)	0 (0)
5. Do you think self-directed learning activities enhance your understanding?	26 (13)	111 (55)	58 (29)	7 (3)	1 (0)
6. After studying the topic-related information and attempting the pre-test is the online lecture is more interesting?	16 (8)	95 (47)	59 (29)	23 (11)	10 (5)
7. Is learning efficiency low without pre-class activity?	21 (10)	76 (38)	74 (36)	30 (15)	2 (1)
8. Are you able to answer with ease after pre-class test and online lecture?	31 (15)	110 (54)	53 (26)	9 (5)	0 (0)
9. Do you think pre- and post-test activities are waste of time?	4 (2)	9 (4)	68 (34)	91 (45)	31 (15)
10. Do you feel pre- and post-class activity helped in retention of information?	26 (13)	123 (60)	46 (23)	8 (4)	0 (0)
11. Do you feel online lectures are sufficient without any pre- and post-lecture activities?	6 (3)	27 (13)	56 (28)	82 (40)	32 (16)
12. Do you want such activities to be conducted for all topics in biochemistry?	37 (18)	91 (45)	58 (29)	16 (8)	1 (0)

pre-test required substantial effort compared to the post-test. The case scenarios included in the pre-test had a positive impact on the curiosity of students. The activities as part of self-directed learning were interesting, enhanced understanding and retention. They felt lectures without pre- and post-tests were less efficacious and therefore pre- and post-tests should be continued in all the classes (Table I). However, nearly two-thirds of the students (62%) felt the time given was insufficient for the pre-test.

DISCUSSION

Online learning is likely to play a larger role as it does not have the limitations of time and space. Online teaching-learning, often referred to as 'e-learning' is the use of internet for the purpose of education.

In a meta-analysis, Pei *et al.* noted no significant difference when using pre- and post-test score gains (standardized mean difference [SMD] 3.03; 95% CI -0.13 to 4.13; $p=0.07$; $n=3$). There is also no evidence that offline learning works better than online learning.⁶ The National Medical Commission (NMC) has recognized the effectiveness of online learning and interactive sessions, and suggested that the teacher must enable the learner to acquire or enhance various skills in learning including self-directed learning (SDL), time management, stress management and the use of information technology.⁷

Most students felt that the time given for the pre-test assignment was insufficient. It may be that the topic was large or complicated for their level of understanding. Therefore, it is better to give pre-assignments that are well-designed, well-planned and in smaller parts for more effective learning to inculcate time management and organization of self-learning environment.

The majority of students felt that the MCQs or BNQs were difficult to attempt. This could be because they were unable to understand the concepts in a subject which was completely new or their preparation was inadequate. However, studies by Buch *et al.* and Kumar *et al.* reported that MCQs were preferred most often by students.^{8,9} Four-fifths of the students said case scenarios induced curiosity during the lecture. This suggests

the need of integration of basic and clinical knowledge. Our study is in agreement with Steinert *et al.* that the use of cases during lectures heightens interest and promotes problem-solving in an effective manner.¹⁰

Two-third of the students felt that SDL enhanced the capacity to understand. SDL means assignments that require students to research and compile information. Our findings are similar to previous studies that showed interactive methods increased understanding in 67.9%–94.1%.^{11–14} Ruiz *et al.* opined that online learning was as effective as traditional didacticism and can be instrumental in promoting SDL.¹⁵ More than half (55%) the students felt the online lecture was more interesting after the pre-test. In the literature, perceptions of students about the effectiveness of online teaching varies from nil to 90%. Bhowmick *et al.* mentioned that not a single student mentioned computer-assisted learning (CAL) as a potential method for teaching-learning. This could be because of ignorance regarding the advantages of CAL.¹⁶ Kositanurit *et al.* from Thailand, observed that online lectures might not be an effective teaching method. Greenhalgh *et al.* in an analysis of randomized controlled trials, found that students in the CAL group did better or similar to students who received didactic lectures.¹⁷ Al-Shorbaji *et al.* in their meta-analysis observed no significant difference between network-based e-learning and traditional learning. They opined that several of the included studies were not of the highest quality.¹⁸

Our results are in agreement with various other studies that active learning strategies created interest, were liked and enjoyed by students.^{8,11–13,19,20} Just less than half (48%) of our students felt that didactic lectures without activities were less effective. Kumar *et al.* also found that a majority (88%) of students liked interactive lectures.⁹ Educational research has shown that students who are actively involved in the learning activity will learn more than students who are passive recipients of knowledge.¹⁰ Rao *et al.* found that students who learnt using active learning strategies did significantly better ($p<0.05$) than students who learnt using the traditional lecture format.⁴

The majority of students (70%) were able to answer the questions with ease after the activity. This was possibly due to

implementation of active learning methods, which increased student engagement with the topic leading to increased enthusiasm and motivation. It also led to more active involvement by the students and contributed to answering the post-assessment tests with ease.

Nearly two-thirds of the students (60%) disagreed that the activities were a waste of time. In similar observations from Parekh *et al.*, 94.9% felt that it is not a waste of time.¹⁹

A majority of students (73%) felt that these methods helped them in retention of information. The academic success of student depends on retention, recollection and reproduction. In similar findings by Kumar *et al.*, 78% of students agreed⁹ and Parekh *et al.* reported that 89.8% of students felt there is a role of interactivity in retention of the subject.¹⁹ Buch *et al.* also reported that a majority of students felt their retention improved.⁸ Steinert *et al.* observed that increased motivation is essential for learning and is often more important than intelligence for retention of the topic.¹⁰

Our study showed that only didactic lectures failed to create interest and students are more inclined towards interactive methods. Similar observations were made by Sander *et al.*²¹ Michael *et al.* found, among students undergoing courses in higher education, better academic outcomes in those who had been taught using active learning methods in courses of higher education.²²

A majority of students wanted these activities to be conducted for all topics in biochemistry. Similar findings were reported by Kumar *et al.* in 83% of students,⁹ Begum *et al.* in 94%,¹¹ Parekh *et al.* in 81.4%¹⁹ and Buch *et al.* in the majority of students.⁸

A majority of students in our study preferred interactivity and online lectures over the didactic method. There was positive feedback also for retention, usefulness, improved understanding, creating interest and effectiveness for SDL of biochemistry.

Our study shows that e-learning is equally effective and active learning methods can be implemented to enhance understanding capacity, create more interest, and improve retention. A majority of students want active learning methods in all the topics of biochemistry. However, factors such as topic, well-planned assignments, technical challenges, teaching style and personality may influence the outcomes. More research is needed to understand the effect of e-learning, validation of various effective active learning methods and their future application in medical educational institutions.

We recommend the introduction of pre- and post-assignments and case-based learnings as the three simple but effective active learning strategies that are easy to implement in online lectures and can be useful for teachers and students in medical education. The advantages of e-learning are that it can be used as per students and teachers convenience and is ideal for SDL.

Limitations of the study

One faculty taught one topic to one batch of students. Few students did not participate at all lectures despite being asked repeatedly. The poor information technology (IT) infrastructure and technical support, as well as modest IT skills of instructors and students were the main challenges for e-learning. Multiple topics with different faculties should have been involved.

Conclusion

Online learning is a more independent and powerful tool to help students in SDL and help teachers to become facilitators of learning. E-learning is useful and feasible in biochemistry. Online teaching, learning and assessment in medical education are still relatively new and have certain difficulties in implementation, but they can be addressed with proper planning and training of stakeholders.

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