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Original Article

Rapid transition to online practical classes in preclinical subjects during COVID-19: Experience from a medical college in North India

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ABSTRACT

Background: COVID-19 pandemic compelled medical schools to opt for online mode in medical education. The competency-based curriculum started in India last year onwards allotted more hours to practical teaching than lectures. As the lockdown extended, there was a need to shift laboratory teaching to online mode. We describe our experience of developing and implementing a framework to rapidly shift practical lab teaching of preclinical subjects to online mode.
Methods: A mixed method study was conducted during the COVID-19 lockdown period in a public funded medical institute of India. A framework utilizing the principles of small group teaching using the available resources was developed and implemented. Online feedback was obtained from students, while in-depth telephonic interview was conducted for teachers.
Results: A Demonstrate-Engage-Assess framework for online Practical teaching of Preclinical subjects (DEAPP) was developed and implemented. Feedback was obtained from 103 first year students and six teachers from preclinical subjects. Around 62%–80% students were satisfied with online practical teaching or agreed with benefits of various online tools used in the teaching sessions. Teachers found the framework more planned, and resource efficient, while students found it to be more engaging, enjoyable, and motivated for learning. No face-to-face interaction, non-experiential learning, and adaptation to newer technology were the main barriers perceived in online practical laboratory teaching.
Conclusion: DEAPP framework was found to be feasible for rapid online transition of practical lab teaching and reported by the students and teachers as engaging, enjoyable and motivated learning.

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Introduction

COVID-19 pandemic compelled medical schools to undergo a rapid transition to online mode of teaching, the only available option to continue medical education.[1] Typically, a student learns in a medical college through three major modalities namely didactic lectures, practical laboratory sessions, and clinical postings, A first-year medical student usually spend her teaching learning hours in lectures and laboratory practical work.[2]

The first transition of traditional classroom to online classes occurred with lectures as it caters to the cognitive domain and are inherently didactic. Practical laboratory sessions aim to develop skills which involve application, analysis and critical thinking, the higher domains of Miller's learning pyramid.[3] Competency based curriculum, 2019 by the Medical Council of India has allocated more teaching hours to practical laboratory sessions and clinical posting compared to lectures.[4]

A rapid shift to online mode for laboratory practical sessions was also urgently needed. We developed a framework to impart laboratory practical teaching in the preclinical subjects and supported faculty and students to implement it during the Covid pandemic related suspension of in-person teaching in our medical college campus. In this paper, we describe the development of an e-learning framework for laboratory practical teaching of the preclinical subjects; and the perception of students and teachers regarding it. This will help other medical colleges to take evidence-based decisions and informed choices when making a rapid transition to online laboratory teaching during any disaster or emergency condition.

Materials and methods

A mixed method study was done in the preclinical departments (Anatomy, Physiology, Biochemistry) of a public funded medical college of Delhi, India in the month of May and June, 2020. The study was approved by the Institutional Ethics Committee-Human Research vide letter no. IEC-HR/2020/44/6. To develop the e-learning framework the following steps were followed;

a. **Literature review:** We conducted a rapid review of the online published literature to understand the protocols which are usually followed for online practical classes for the above-mentioned disciplines. A search was also made to find out different computer-based applications which can help in increasing students' engagement and participation.
b. **Mapping of resources available:** It was found that the following resources were available 1) digital platform GoToWebinar (LogMeIn, Inc., Boston, Massachusetts, 2020); this was obtained as an emergency response by the institute in order to continue with online lectures as a response to ongoing COVID-19 pandemic. This platform has embedded features viz. adding YouTube videos, polls and survey, and providing handouts. 2) A functional Medical Education Unit (MEU) which conducts medical education related faculty development programs; 3) A functional Department of Biostatistics and Bioinformatics (DBMI) which manages the software and internet issues; 4) Teachers: who were already using the digital platform for online didactic lectures 5) Residents were involved in teaching laboratory practical classes and were familiar with the GoToWebinar digital platform; and 6) availability of internet facility in all concerned departments.
c. **Discussion:** A series of discussions were held among the MEU members and teachers of preclinical departments. This was to decide upon a framework for online laboratory practical teaching which was effective as well as feasible. The following issues were agreed upon; 1) The principles of Small Group Teaching such as engagement, and planned interaction to be incorporated in the framework. 2) Use of questioning behaviour/technique.[5]: This was based on the evidence that when a question is asked the students think, analyse and answer, an activity which leads to active learning and is vital in laboratory practical teaching. It was also discussed for inclusion of open-ended questions, which encourage students to figure out the answers independently from the information they already have. 3) To add fun component while teaching and 4) Assessment, especially self-assessment came to be a core component of the framework.
d. Communication: The head of the concerned departments were briefed and a detailed plan was developed.
e. Faculty and student support: Development of screenshot-based guide booklets for teachers and sensitisation of all the teachers involved in conducting practical classes were done. Issues faced by teachers in conducting and students in participating in the practical classes were addressed by MEU on a regular basis.

Feedback from the teachers and students was obtained to know their perceptions about the DEAPP framework. 1) *Teachers* – In-depth telephonic interviews using an interview guide, were conducted with the teachers within 24 h of their conducting online practical teaching. This was to get feedback regarding the facilitators and barriers regarding conducting the online laboratory teaching. The responses were noted by the interviewer as verbatim quotes. 2) *Students* – At the end of the planned activity, feedback of the first-year medical students was collected anonymously, using pre-tested Google Forms. The first section of the questionnaire consisted of the purpose, voluntary nature of participation and informed consent. Using a mix of closed and open-ended questions, the questionnaire collected information pertaining to i) demographic information, age, gender, state of residence ii) reactions to use of the developed framework for online laboratory teaching. Reaction was measured on a five-point Likert scale for level of satisfaction with the online laboratory teaching. iii) perceived facilitators and barriers to online laboratory teaching and learning.

Data analysis

Mixed method data analysis was done. For quantitative analysis SPSS Software (Version 20.0 for Windows, Armonk,

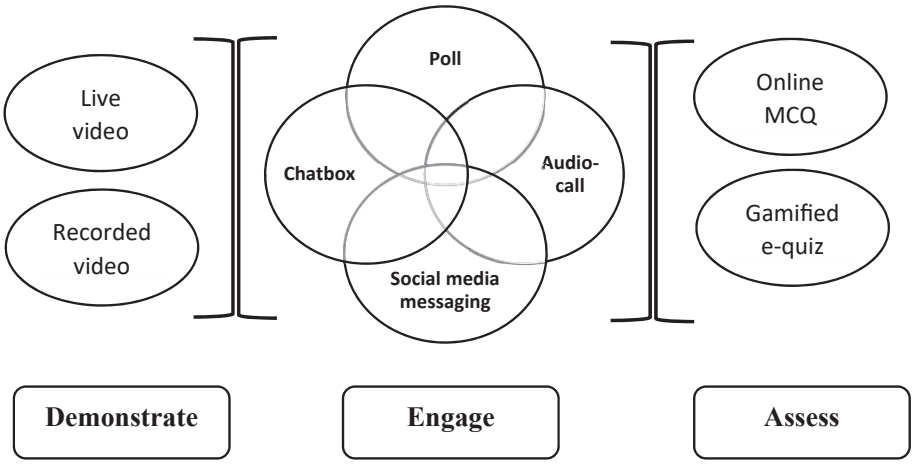

Fig. 1 – Demonstrate-Engage-Assess framework for online Practical teaching of Preclinical subjects (DEAPP).

NY: IBM Corp) was used and simple descriptive statistics like proportion and means were calculated. For qualitative data, thematic analysis was done for description of challenges faced and benefits associated with online teaching. Coding and recoding of the responses were done independently by the authors and matched. A mutually agreeable set of themes were generated. We present the list of themes with select quotations.

Results

Demonstrate-Engage-Assess framework for online Practical teaching of Preclinical subjects (DEAPP framework) (Fig. 1): This framework ensured the following principles a) Interaction b) judicious use of questioning behaviour which made students to think and critical analysis c) Students to assess their learning in an environment of healthy competition.

Online video-based demonstrations, either live or recorded, formed the base of online practical teaching. Student engagement was assured using the polling feature of GoTo-Webinar platform which collected students' responses in real time and was displayed on the screen. These polls consisted of rhetorical questions, which helped in thinking and further discussion. For self-assessment freely available, online gamification platform Quizizz (Quizizz, Quizizz Inc. Bangalore, Karnataka. 2020) was used. The teachers created multiple choice questions on the topics taught in the session and students answered through the device used for the online class.

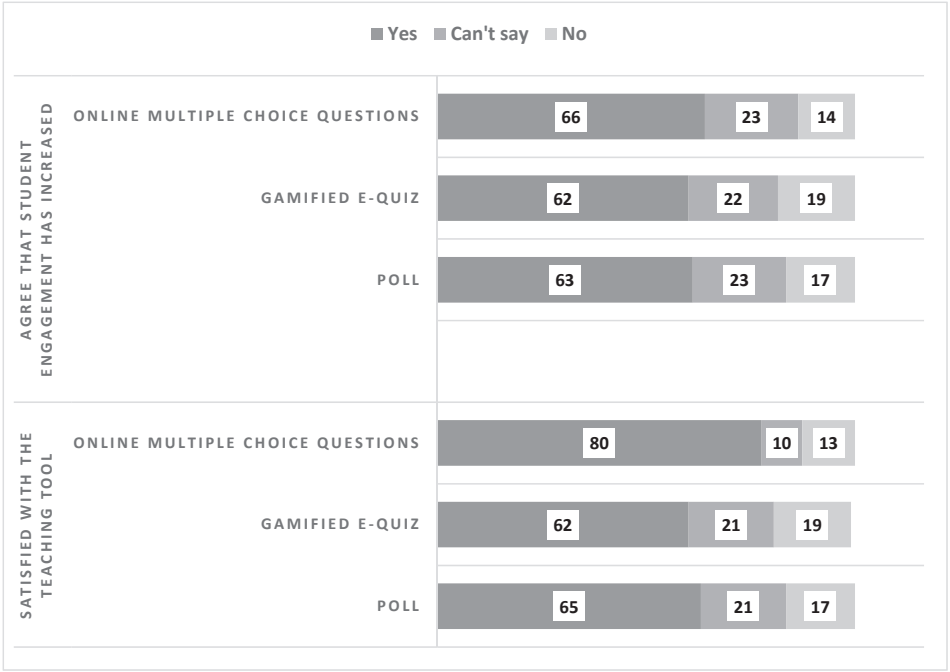

Fig. 2 – Agreement with the statement that 'Student engagement has increased' and satisfaction status with the Poll, Quiz, and Multiple-Choice Question components of the Demonstrate-Engage-Assess framework of online Practical teaching for Preclinical subjects (DEAPP) (n = 103).

Teachers' assessment was done through online MCQs by using Google form and generic feedback was provided. Table 1 highlights the differences between the online practical teaching conducted earlier without using the framework developed and later, with using the framework in the present study.

Characteristics of the study participants

Teachers' characteristics

A total of six teachers, two from each of the preclinical departments of Anatomy, Physiology, and Biochemistry were interviewed. The teachers included two senior residents, and the minimum teaching experience was two years.

Student characteristics

A total of 110 out of 158 first year medical undergraduate filled the feedback form. Four did not give consent, and three students had not participated in any of the online practical classes, so, the final analysis included 103 respondents.

The mean (SD) age of the students was 19.4 (1.6) years. Around two third (71/103, 67.0%) were male and around half (54/103, 52.4%) of the students were from state of Delhi.

Reaction of the students to the DEAPP framework

Around 62–80% students had reported as satisfied or agreed with the statement that 'student engagement has increased with different tools (polls, gamified e-quiz and online MCQs) of the DEAPP framework (Fig. 2).

Perceived benefits associated with DEAPP framework

Seven themes were identified (Fig. 3).

Engaging

"These (Polls, Gamified e-quiz) were far better, far interesting class, obviously very very interesting. It helped in eliciting the reaction of the students." "through polls by asking questions we can emphasize on something." (Teacher).

"I was like more attentive in class because i know that there is a question waiting ahead." "If you get a question wrong, you're intrigued to find out the correct answer which helps the learning process." "Idea of understanding of all our fellow mates and also what majority is thinking." (Student).

Session recording

"We can (later) watch recorded videos of our own teaching and how to improve them."

(Teacher).

"I feel online classes are better than offline classes that were held earlier. Now we have most of the videos of the classes. Those are actually good and helps us for future references. In offline lectures it was very difficult to make notes of everything." (Student).

Planned session and better control

"Planning is better in online teaching. We have to do more planning and obviously that has improved the things." "better control over our presentation" (Teacher).

Class room disturbance

"In traditional classes students will interrupt you in between. The students making noise is not there in online classes. This is a good thing." (Teacher).

Resource efficient

"We can reach many students online at a time and our reagents are also saved and not used."

"Danger of chemical spilling is also not here." "Usually students are a huge crowd and we can't show procedures and equipment properly. Here in online mode it is easier." (Teacher).

Enjoyable

"Helps to know concepts precisely in a thrilling way." "Quiz was like fun. Testing our knowledge and competing with others." "We get a scoreboard, our name hopping among the ranks, accessing reaction time, etc." (Student).

Motivates to learn

"These classes instigate me to study." "It allows me to assess how much I have understood or learnt during the class. Also, one is able to remember things for longer time once you solve out questions on it." "Question-answer format of learning is the best way of arousing curiosity in my opinion." (Student).

Perceived challenges associated with online laboratory practical classes using DEAPP framework

Seven themes were identified (Fig. 4).

Non-experiential learning

"Students are not performing on their own. Like in practicals we used to have role playing by one student acting as patient.

Table 1 – Observed differences between the online practical classes before and after the development of the Demonstrate-Engage-Assess framework for online Practical teaching of Preclinical subjects (DEAPP).

Characteristic	Online Practical classes before framework development	Online Practical classes after framework development
Structure	Unstructured and based on the preference of the individual teachers	Structured and well defined
In-session learning activities	Monotonous	Diverse
Teaching tool	Mostly PowerPoint slide presentations were used	Videos: live stream, recorded in-house or YouTube links
Interaction	Minimal or based on individual teacher's preference	Frequent and planned, mainly through questioning technique
Communication	Didactic delivery of content, similar to lectures	Two-way communication
Assessment	No assessment for learning	Assessment for learning concept embedded within the session
Fun-component	No	Yes

We used to perform everything like where one have to stand, how are you going to put the stethoscope. It is not possible to teach all those things."

"Usually in traditional classes students are provided with bones in Anatomy practical classes. They touch it and feel it each and every part of the bones. I feel only video demonstration is not enough." (Teacher).

"We are missing cadaveric dissection." "we're not able to practice and don't really understand how to perform certain procedures like I still haven't understood how to do percussion and auscultation properly." (Student).

Technical issues

"We always worry about the internet and network." "Lots of time is wasted." (Teacher).

"Recorded videos are not usually clear enough to understand and lags a lot." "Since I was using mobile, I wasn't able to unmute myself." (Student).

Interaction

"No face to face and interaction. We could also see who is having problem in understanding."

"We can't see students who are not paying attention" (Teacher).

Newer technology

"Difficult to train all teaching staffs with new things. Just now taught them online MCQ using Google form MCQ and then this e-quiz is difficult to adapt too rapidly." (Teacher).

Format of assessment

"All assessments are in multiple choice questions." (Student).

Time management

"We don't know when the teacher will end taking responses. And there is no timer displayed so sometimes we are unable to submit our responses and the teacher ends the poll." "Wastes time. Like you have to wait for everyone to finish and then for the teacher to tell that how many of us did it wrong and what's the correct answer." (Student).

Comprehension

"Sometimes teacher does not explain or even confirm the answer after poll result. They might forget to do so. It affects my understanding of the topic." (Student).

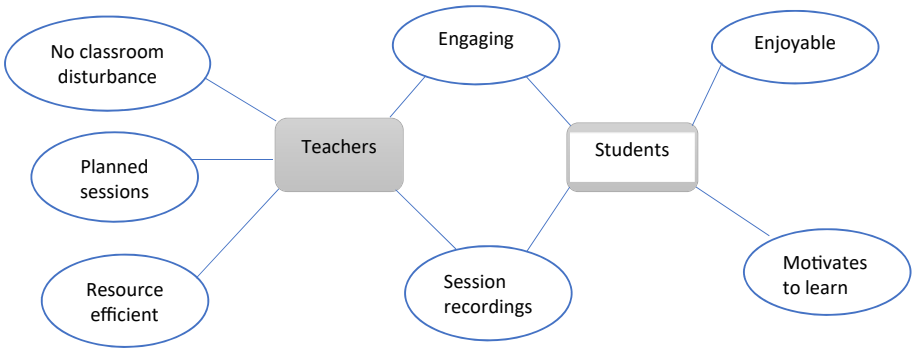

Fig. 3 – Facilitating factors for teaching learning by the Demonstrate-Engage-Assess framework for online Practical teaching of Preclinical subjects (DEAPP) as perceived by the teachers and students.

Continuation of online practical laboratory classes in future (post pandemic period)

Around half (50/103, 48.5%) of the students wanted that in the post-Covid period, practical classes should be conducted using blended teaching i.e. a mix of online and offline, another 48.5% (50/103) wanted that it should be by offline (in-person) teaching only and no online component should be used, and a few (3/103, 2.9%) favoured online-only mode.

Teachers reported "mixed (online and offline) methods are better." "Both online and offline modes should be mixed for practical teaching in future."

Discussion

A culture of online teaching was developed in the institute in a rapid mode during initial period of suspension of in-person classes due to COVID-19 Teachers and students support systems were developed and put in place for an effective environment of online learning. As laboratory practical sessions are different from lectures, a DEAPP was developed in order to continue laboratory practical classes. The article represents the 'transition' phase of online laboratory teaching. As **changes** in medical education **is** a gradual step wise process, we introduced **at-least** one tool for all the **mentioned** components i.e. Demonstrate, Engage, and Assess of the DEAPP framework. More **innovative tools for each of these three domains may be explored and added later in a step wise manner.**

Laboratory based practical sessions are important in medical education as these help students to understand procedures and underlying theory. We surveyed the first-year undergraduate medical students and majority of them reported as "satisfied" and "engaged" to different components of e-learning framework DEAPP. Demonstration helped the students to understand a procedure and worked for students reporting and analytical skills. Other studies have also reported the demonstration by sharing of texts, images, video and audio clips[6] and also creation of "dry digital labs" in online environments.[7] Video based demonstration for laboratory practical teaching has been reported by other studies too.[8,9] The developed videos also helped the students for self-paced learning and worked as medium of microteaching for the teachers.

Conceptual learning was also facilitated by engaging the students through Polls and quiz es. Polls helped in a sense of aggregation[10] and self-perceived attentiveness[11] among the students and also helped to work as trigger to facilitate further discussion on the topic and clarification of understanding. Quizzes were based in theory of gamification. Quiz helped both in engagement and assessment. Students were able to get instant feedback and thus do self-assessment. Though there are apprehension that gaming features may increase the anxiety of the students.[12] As found by this study literature reports that, game-based learning also

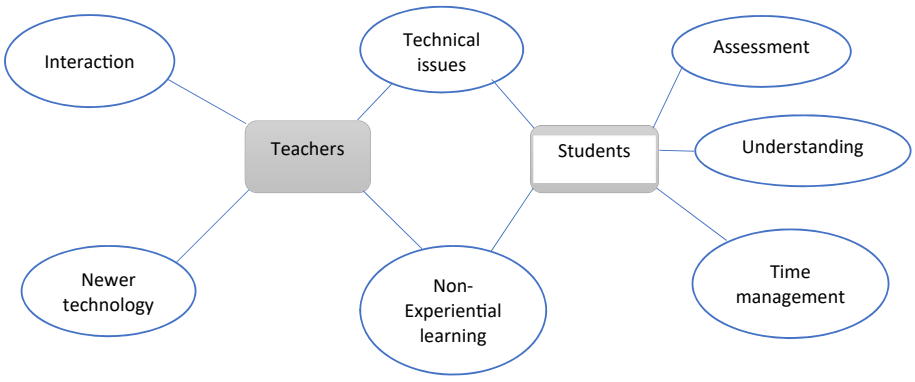

Fig. 4 – Challenging factors for teaching learning by the Demonstrate-Engage-Assess framework for online Practical teaching of Preclinical subjects (DEAPP) as perceived by the teachers and student.

promotes healthy competition among peers,[13] improving their motivation[14] and help them to evaluate their own learning. It allowed learners to learn through a competitive, non-threatening, low stakes activity and they got real-time feedback. Online quiz involved MCQs and literature shows that different levels of Bloom's taxonomy can be assessed by this assessment format.[15]

Students engagement throughout the class was encouraged and ensured not only through the digital platform during the class but also through social media messaging apps and personal emails after the class. Participation not only makes the learning enjoyable but also helps in retention.[16]

It was noticed that almost half of the students and all the teachers expressed desire for future classes through blended method. Online mock laboratory activities are reported as a cost-effective alternative to traditional wet labs for medical students.[17] In blended learning approach online teaching can cover the theoretical and procedural teaching and the in-person classes can involve student's skill development.[18]

Prior to implementation of this DEAPP framework in different medical colleges, we suggest, resource mapping and brainstorming session should be conducted to decide on how to adapt this framework in the respective setting while considering the local logistics and broad principles in mind.

The limitations of this study are that it is a single centre study, and we could not do long term follow up. We could not directly observe the quality of teaching or assessment done by the teachers and so cannot comment on the effect of the framework on the learning of the students specially on understanding and retention of the acquired knowledge. No comparison with offline practical classes were done.

Conclusions

The DEAPP framework which is comprised of online tools, such as embedded polls and e-quiz will help in rapid establishment of online laboratory practical sessions specially in resource poor settings during the Covid pandemic lockdown. Online laboratory teaching is feasible and is enjoyed by medical students when engaging activities and gamification of assessment are embedded in the session. Blended learning may emerge as the preferred mode for practical laboratory teaching in medical education once the medical schools reopen in future.

Disclosure of competing interest

The authors have none to declare.

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