

Online Videos as a Supplement Tool to Train II MBBS Students in Drug Administration Skills

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Abstract

Objective: To evaluate the effect of online videos along with traditional teaching on learning pharmacotherapeutic skills. **Materials and Methods:** Eight videos illustrating skills required for drug administration by parenteral and inhalational routes were developed and uploaded along with additional resource materials on a dedicated website. Following an online pretest, two practicals on routes of drug administration were conducted for 181 II MBBS students. They were then allowed to voluntarily watch the videos. Video usage, change in knowledge (pre- and post-video observation test score), and performance (Objective Structured Clinical Examination [OSCE] scores of two internal assessments) and perceptions (using prevalidated questionnaire) were recorded. **Results:** The average number of videos watched/student was 7.50 ± 1.30 , whereas the average number of times each video watched was 1.50 ± 0.094 . Only 39 students watched the videos before the first internal assessment were found to have statistically higher OSCE score compared to others who failed to watch ($P = 0.006$). The latter group watched the videos subsequently and showed improvement in their OSCE scores in the second internal assessment as compared to the first one (14.28 ± 3.26 ; $P = 0.001$). Students (93.10%) perceived the online videos as useful teaching tools, which helped them to understand and retain the sequence of procedural steps of the skills better. **Conclusion:** Drug administration skills when taught using a blend of traditional teaching methods and online videos, improved the performance with added reinforcement. Student acceptability was high indicating online videos can serve as a supplementary tool.

Keywords: E-learning, in house videos, Objective Structured Clinical Examination, procedural skills

INTRODUCTION

The Pharmacology curriculum for undergraduate medical students is designed to empower the graduating students to use the knowledge regarding common and essential drugs judiciously while making decisions in clinical settings. However, the present curriculum gives more emphasis on providing factual information about drugs rather than any hands-on exposure to skills required for patient care. The traditional teaching methods include lectures, tutorials, and practicals, but the teaching is mostly directed toward information dissemination rather than active learning by the students. As a result, the students perceive the subject as a volatile bundle of facts.^[1] A change in approach is needed to impart certain pharmacotherapeutic skills to the students. Such skills would help to reduce the stress and anxiety of students during patient encounters. It may be ideal to allow supervised patient encounters or use standardized patients to provide

experiential learning, but due to various logistic reasons, such interactions may not be feasible. Hence, to enhance the skill training of the students, help of appropriate techniques and technologies needs to be sought.

Simulation-based supportive tools, namely, mannequins, robots, audio recordings, and videotapes are in use to impart skill training.^[2] Videos are commonly used in lectures and practicals to demonstrate certain techniques. It has been shown that they sustain the interest of students. Students are

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able to grasp difficult concepts easily due to visualization and understand the topic better.^[3] They help students remember the facts and develop psychomotor skills. This is possible because continued access to the learning material is available, which encourages self-directed learning.^[4] However, the latter may not be possible with the use of only class-based videos, which are shown for limited time and are not interactive. Students of today are more technology savvy and comfortable with the use of different e-learning technologies.^[5] E-learning is also a part of “flipped classroom” in which students gain first exposure learning for a particular topic outside the class in the form of online resource material and afterward focus on processing part of learning in the class.^[6] E-learning provides flexibility in time, pace, and place for learning and also allows on-demand access to the learning materials, thus maintaining learner’s control. The use of these technologies promotes active learning with better retention of knowledge. They also promote self-directed learning.^[7-9]

Although the use of e-learning in medical education is well established, its use in pharmacology skill training is still in infancy. Various topics (dosage forms, routes of administration [ROA] of drugs, rational selection of drugs, communication of prescription to patients, etc.) covered in the pharmacology practicals have the potential to familiarize the students with various pharmacotherapeutic skills. However, the demonstration and practice of such skills are not feasible due to the lack of adequate facilities, and the teaching in practical is perceived as theoretical by the students.^[10] Online videos may bridge this gap and serve as an additional learning resource, which provides procedural details involved in skill learning. If these are observed repeatedly then they may help in understanding nuances involved in a particular skill, especially for the beginners and prepares him/her for the skill practice later on. It was therefore thought worthwhile to develop and use in-house online video clips pertaining to drug administration skills as a supplement to traditional practical teaching and evaluate effect of such blended approach on skill performance.

MATERIALS AND METHODS

Study design

The design of the study was prospective, single-arm study. After obtaining permission from the Institutional Ethics Committee of the Seth GS Medical College and KEM Hospital, the project was initiated in accordance with Ethical Guidelines for Biomedical Research on Human Participants (ICMR, 2006) and Declaration of Helsinki 2008. Students of II MBBS course (3rd semester) and willing to provide written, informed voluntary consent were included in the study. The total duration of the study was approximately 1½ years.

Intervention

Development of in-house online videos

A core committee of the three facilitators from the Departments of Pharmacology, Medicine, and Chest Medicine was constituted for exploring the feasibility, shooting, and uploading of the videos

on an electronic platform along with timelines. The committee members decided that video clips illustrating procedures of parenteral and inhalational administration of drugs should be prepared as this skill is essential for any clinician practicing any field of medicine. Based on this, 8 online videos were planned: 1. Introduction to parenteral ROA consisting of information about the instruments/equipment required for the same; 2 and 3 Withdrawal of medication from ampoule, and from a vial respectively; 4, 5, 6, and 7 Procedures for intradermal/subcutaneous/intramuscular/intravenous injections, respectively; 8 Instructions regarding how to use metered-dose inhaler (MDI) with or without spacer. The members formulated specific learning objectives, decided contents of each of the videos, and the assessment strategy. Following adequate deliberations, the committee also finalized steps of the procedures to be displayed in the videos and their sequencing, narration script, resources required for each of the shot, the area for shooting, and other technical support required for the same. It was decided to do the shooting in a real-world setting of clinical wards after taking permission from the patients. The narrator was identified and provided the script, which included the brief history of the patients, details of the drugs to be administered, each procedural step that would be performed by the doctor and explanation thereof if any. In addition, supplementary resource material for the students was searched and finalized.

Along with seven videos, which demonstrated procedures, the lists of procedural steps were provided. The objective structured clinical examination (OSCE) checklists (10 steps) for assessment by the faculty were also prepared. The checklists indicated the sequential steps of the procedures with marks assigned to each step (total 10 marks). These were validated by the faculty members of Pharmacology, Medicine, and Chest medicine.

Eight online video clips, each of 2–5 min duration, were shot using the handheld camcorder in the side room of a ward, which had restricted access in direct sunlight. Narration in a male voice was included in all the videos and edited if required. The final file format was a flash video (using Microsoft Windows Movie Maker 2.1 and Freemake Video Converter 3.0.2.9). The completed video files were uploaded on a dedicated website with the help of Moodle (2.2.1-Open-source learning platform), which was designed with the help of a professional web designer. These flash videos could be viewed with any standard web browser with a Flash plug-in and an audio headset. Along with videos, write-ups for each video stating the objectives, procedure in narrative manner with precautions to be taken and the accessories required for the procedure, for example, needles, their types and numbers, etc., was available at the website. Lists of procedural steps were provided. In addition, resource articles on ROA were uploaded for additional reading.^[11]

Implementation of online videos

Following the assessment of Internet literacy skills of the II MBBS students, those who did not have sufficient skills were trained by the department faculty, to enable their participation in online video learning modules.

Students were given a period of 20 days to register on the dedicated website [Figure 1a and b] (www.astrobhagya.com/moodle/index.php) and complete the video observation pretest.

At the end of this period, the practicals on “parenteral and topical ROA of drugs” were conducted as per the university syllabus in traditional method which involved demonstrations using mannequin along with narration of the dosage formulations, parenteral dose calculation, preparation of solution for injection and steps involved in intramuscular, intradermal, intravenous, and subcutaneous injections and using MDI. The first practical focused on parenteral routes of drug administration and demonstration of topical dosage forms – MDI including the instructions to be given to the patient regarding how to use an MDI with and without spacer were covered in the second practical. At the end of each practical, the students were asked to complete the printed exercises in the practical record book which were based on what they observed during the class, i.e., the steps for each of the ROA and instructions to be given to the patient.

After conducting these practicals for the entire batch, the students were informed that the online videos of the practicals they have undergone have been displayed on the registered website and can be accessed whenever they wish to do so. They were instructed that after watching the videos for the first time, they have to give an online postvideo observation test. The videos were displayed on the website for students to watch multiple times even after giving the postvideo observation test. The students were also informed that in both first- and second-term internal assessments, along with spots, two OSCE stations (giving the intramuscular injection and instructing a patient on how to use MDI with or without spacer) would be included. Students were also requested to fill the online student perception questionnaire.

Multiple instruments were designed before implementation to evaluate the effect of online video as a supplement tool to train in the skill of ROA of drugs.

Instruments

1. Questionnaire (10 items) was designed to assess the internet literacy level of II MBBS students

2. Online pre- and post-video observation tests were designed in consultation with subject experts and prevalidated. These tests included 11 multiple choice questions based on all the video clips with one or more than one correct alternatives. The maximum marks for all correct options were 15
3. OSCE checklist was the second instrument. These checklists were prepared as mentioned above and validated. It was decided that in the 1st year of project, the students would be shown all the video clips, but while assessing their performance at the end of the first term, only two skills, namely giving the intramuscular injection and explaining how to use MDI, would be selected. The assessment was done by a fixed team of trained faculty members of Pharmacology Department
4. An online student perception questionnaire consisting of 13 statements was designed, wherein the responses regarding the agreement were rated using 5 point Likert scale as 5 - strongly agree, 4 - agree, 3 - neutral, 2 - disagree, and 1 - strongly disagree. Students were asked to tick one of the alternatives to indicate their response. At the end of the questionnaire, a comment section was provided to record the opinions about the online videos and suggestions for their improvement, if any. The face and content validity of the questionnaire was checked by the experts in medical education, pharmacology, and medicine.

Indicators

The indicators included:

1. Number of students accessing each video, average number of videos watched by each student, and the average number of times each video watched
2. Improvement in knowledge component as judged by the marks obtained in the prevideo observation test and postvideo observation test
3. Improvement in skill performance as OSCE scores
4. Percentages of students showing positive remarks for the effectiveness of online video as a teaching tool. The positive remarks included score of 4 or 5 and negative remarks as score of 1 or 2 on the Likert scale for each statement in the perception questionnaire.

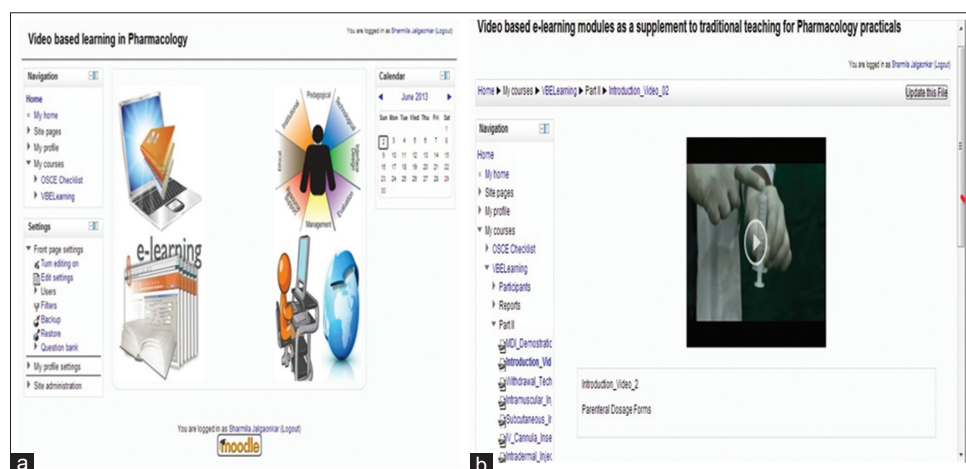


Figure 1: (a and b) Dedicated website for online videos

Statistical analysis

GraphPad InStat, version 3.06 (Company – Graphpad software, Inc, San Diego, California 92108, USA) was used for statistical analysis. The student's paired *t*-test was used for before-after comparison of marks obtained in pre- and post-video observation. The OSCE scores of the students watching the videos before the first-term examination were compared with those who did not watch using unpaired *t*-test. For the students who watched the videos only in the 2nd term, their scores in the first OSCE were compared with the next OSCE in the second internal assessment using paired *t*-test. For all the tests, two-tailed $P < 0.05$ was considered as statistically significant. Descriptive analysis was used to assess the individual questions on student perception questionnaire. The responses were expressed as percentages.

RESULTS

Of the 183 students, 181 students gave written informed consent. Of these, 178 were found to be internet literate (scored $>7/10$). The remaining three students were trained to access the internet and the site.

During the first internal assessment, 142 students did not watch the videos (stratified as Group A), whereas only 39 students watched the online videos before the first internal assessment (Group B). Group A students did watch all the videos in the second-term and Group B students continued to watch the videos even before the second internal assessment. The average number of videos watched by each student was 7.50 ± 1.30 . The average number of times each

video watched was 1.50 ± 0.94 . The average OSCE scores of all the 181 students in the first internal assessment were 13.53 ± 3.63 . It was found that average OSCE score of 39 students who watched online videos before this OSCE was better (14.92 ± 3.86) as compared to those of 142 students who failed to watch (13.13 ± 3.47 ; $P = 0.006$). However, when the latter group watched the videos in the second term, their marks were found to increase in the second internal assessment compared to their performance in the earlier examination [14.28 ± 3.26 ; $P = 0.001$; Figure 2]. Pre- and post-video observation tests were given by 134 students. The postvideo observation test marks of 10.48 ± 1.63 were found to be significantly higher than the prevideo observation test marks, 4.51 ± 4.31 [$P < 0.0001$; Figure 3].

The online perception questionnaire was filled by 168 students. The perception of students toward online videos as a supplemental tool is presented in Table 1.

DISCUSSION

Pharmacotherapeutic skill training is essential and is covered in practicals more in theoretical manner. The transition of medical students to interns requires them to be experts in drug administration skills. In a pilot study conducted by Vasundara *et al.*, interns felt that pharmacology should be taught with more clinical cases and also should be integrated with clinical subjects. The study also emphasizes the need for a change in pharmacology curriculum toward producing efficient doctors for better patient care.^[12] In a perception study conducted by Goyal *et al.* 60% of the second MBBS students opined that pharmacology as a subject is relevant and useful for future professionals, and hence, the authors have suggested that there should be an increased emphasis on problem-based, contextual, and self-directed learning.^[13] It was felt by us that this can

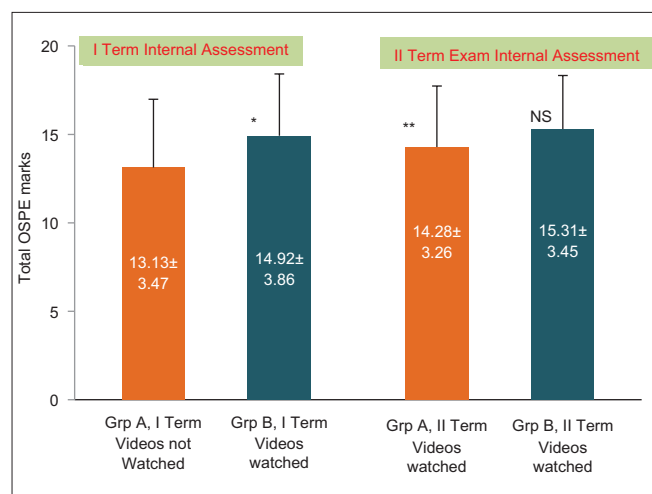


Figure 2: Comparison of objective structured clinical examination marks of the students. Group A ($n = 142$): Students who failed to watch online videos before first-term practical examination; Group B ($n = 39$): Students who watched online videos before first-term practical examination; Unpaired *t*-test* Group A versus Group B first-term objective structured practical examination marks ($P = 0.006$); Student's paired *t*-test** Group A first-term objective structured clinical examination marks versus Group A II term OSCE marks ($P = 0.001$); Student's paired *t*-test^{NS} Group B first-term objective structured clinical examination marks versus Group B II term objective structured clinical examination marks ($P = 0.5$)

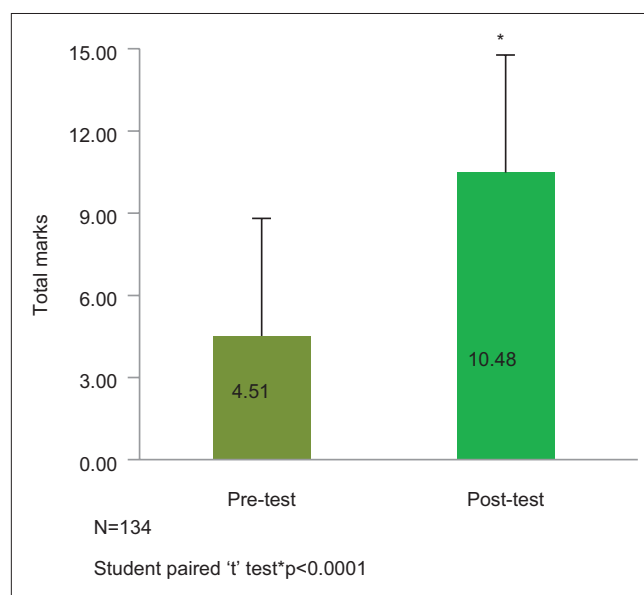


Figure 3: Comparison of marks obtained in pre- and post-video observation test

Table 1: Perception of students about online videos

Questionnaire element	Percentage agree (score 4 or 5)	Percentage neutral	Percentage disagree (score 1 or 2)
A. Students general perception about videos of parenteral ROA			
1. It was easy to download online videos from the link provided by teachers	85.02	12.57	2.41
2. The online video clips could be easily opened	72.21	20.35	7.44
3. Quality of online video clips was good	73.05	19.76	7.18
B. Perceived benefits of online videos as teaching tool			
4. Prior practical session provided platform for understanding these procedures in online video clips very well	85.02	12.57	2.39
5. I enjoyed watching online video clips	68.02	28.12	4.21
6. This is a good additional learning method	84.24	12.32	3.42
7. Learning of procedures through online video clips helped me to understand and remember it better than face-to-face teaching	77.10	18.67	4.21
8. Procedures in online video clips helped me to prepare for practical examination	93.41	5.38	1.19
9. Online video clips encouraged me to do the procedures on my own	69.65	26.20	4.13
10. Online video clips allowed revision at a convenient time and place	88.35	7.53	0.68
11. These online videos are an useful tool for learning clinical skills	93.10	6.20	0.68
12. Online video clips present correct demonstration of a procedure and removes staff-to-staff variation	79.31	17.93	2.75
13. Online video clips should be prepared for other topics of the practicals also	77.84	17.36	4.79

ROA=Routes of administration

be achieved by taking the support of available technology to make the subject clinically oriented. Our attempt is based on the suggestion that emerged from the survey conducted by Majagi, *et al.* that e-learning should be introduced along with clinical pharmacology and bedside teaching.^[14]

One of the important teaching-learning tools identified was video. Videos can stimulate interest in students, grab their attention, and motivate them to learn.^[15] de Leng *et al.*, who used video case studies in medical education, concluded that the videos provide students a realistic depiction of the clinical diagnosis and treatment of patients.^[16] In a study conducted by Braun, only 20% of students indicated a 100% online course as a preference compared with 77.8% who indicated a hybrid course, one that mixes online instruction with traditional classroom elements.^[17] Hence, with this background in mind, we developed low-cost videos in our setting, which can be used with traditional teaching methods.

The topic for the present study selected was “Routes of drug administration.” This topic is a part of the current pharmacology syllabus and taught in a practical class but merely by showing accessories needed and giving description or using a mannequin. It was felt that the addition of online videos would help the medical students to master this essential pharmacotherapeutic skill of drug administration in the early phase of their curriculum to become competent healthcare professionals. It has been reported by Ayuob *et al.*, that when a clinical skill module was introduced for medical undergraduates in King Abdul Aziz University, there was a marked improvement in the students’ perceptions regarding most of the clinical skills including intradermal and intramuscular injections as well as insertion of IV cannula.^[18] Hence for two practicals, we used blended teaching approach

consisting of coverage of routine practical syllabus as face-to-face interaction in class and the use of online videos with supplementation of resource material along with lists of procedural steps. The latter was prepared to enable the students to focus on the important steps to be carried out sequentially.

In the present study, all eight videos were watched by the majority of students which signifies that all the videos related to parenteral ROA were considered important by the students. The average number of times each video was watched was 7.50 ± 1.30 . However, this figure may be deceiving because of the possibility of group watching of videos by the students, wherein one student downloads video on application like computer or mobile, which is then watched by other students as well. Among the students who watched videos before first terminal OSCE examination ($n = 39$), though the videos were available for watching throughout the study period, the maximal watching occurred 2 days before the practical examination during the examination period and abruptly declined after the examination. This is in concordance with the principle that assessment drives learning as the students considered these videos as a preparatory tool for assessment. Students were also very prompt to download the resource material, i.e., article, procedural steps and narrative write-ups related to ROA of drugs hoping to be helpful for OSCE examination in pharmacology. It was also found that the resource material was downloaded by approximately 80% of the students, inclusive of those who did not watch the videos.

Pre- and post-video observation tests were incorporated in the study for eliminating any bias of previous exposure to the subject matter and to assess the improvements (if any) in student knowledge after watching videos. The results of these

tests did show a significant difference, almost doubling of initial score. This was expected as the students were trained both, in the practical class and allowed to watch videos for reinforcement of the knowledge component. However, when the performance was assessed in the first internal assessment, it was found that those students who watched had significantly better performance (14.92 ± 3.86) in the OSCE than who did not (13.13 ± 3.47). This finding is similar to that reported by Priston *et al.*, who developed e-learning module having video clips to impart skills to physiotherapy students.^[19] There was an improvement in the performance of practical skills in students who had access to the online physiotherapy e-Skills training module in addition to usual teaching. In our study, though the difference in the performances of two groups was statistically significant, the difference in scores (nearly mean increase by 1.5 marks) was not very appreciable. Even the group who had watched the videos and then gave the OSCE had a mean score of 14.92 out of 20 marks. These students did not achieve marks closer to 20. This can be explained by the fact that these students were being exposed to OSCE as pattern of assessment for the first time; hence were not able to value each step of that particular skill. In addition at present, in the summative examination, skill-testing on ROA is not included. Students are asked in the viva about the steps of drug administration by a particular route.

It was also observed that the group which did not watch the videos earlier, showed a statistically better performance in the OSCE after watching it; again with a difference of 1–2 scores. The possible reasons could be learning through multiple other sources available to the students without watching the videos directly from the website, like the notes in the practical record books, written resource material downloaded from website, group watching of the video downloaded by their peers or observations of techniques during their clinical postings. The OSCE checklist used by the faculty was binary and related to sequential steps which students were provided with and did not capture how well the technique was performed.

The understanding of the concept and steps of the given clinical skills is important before the actual performance of the skill. Thus, after the blended technique, the knowledge component underlying the performance of skills was found to improve, and students were better prepared for performance. This better understanding of sequential steps involved in the clinical skills helped students to perform better in OSCE as seen from the OSCE scores of the students, who watched online videos before the first and second internal assessment.

In a similar study, Roshier *et al.* developed online videos as learning resources, for the 1st, 2nd and 3rd-year undergraduate students of veterinary college. They too reported that the students showed the positive perception of video usage and showed increased usage before OSCE examination.^[20] However, students had some technical problems regarding downloading of videos, too long length of videos, poor audio quality, etc., Based on their own experiences, the

authors of this study have provided guidelines for creating video resources. These guidelines were utilized by us also to prepare videos using low-cost resources like handheld camcorder which were edited afterward using free downloaded software.

Whenever new educational resources are developed with new technology, the most important factor that has to be considered is the accessibility to the benefiter, i.e., students and comfort of students for using this new technology. To ensure the same in the present study, the computer and internet knowledge of the students was assessed in the beginning, by the administration of computer literacy questionnaire to the students. Students who were lacking in the same were trained for accessing the videos. Because of these efforts, our students expressed less difficulty to access the given link (92.21%) and download videos from the given link (85.02%). However, apart from content and context of the videos, the students do regard the qualities of resource videos as an important feature.^[21] About 73.05% of students gave favorable opinions about the quality of the videos.

Another important feature of our online videos was that they were shot in real patient scenarios featuring the faculty teachers from the departments of medicine so that students would relate themselves immediately to the scenarios displayed in the videos. The advantages of low cost videos as evident from our study are also shared by Simoa *et al.*, who have defined the low cost educational videos as “short demonstration stream video, which has a very specific goal and can be created in a very short period, with few resources and can be combined or embedded within other materials of a course.”^[22]

The utility of video as a teaching tool was supported by the students' perception that the use of videos helped them to understand and remember the procedure better (93.10%). It also helped them to prepare for practical examination (88.35%). The students also felt that online videos allowed them to revise at a convenient time and place (93.41%) with comfort. Online instructions are preferred by the students when they are mixed with face-to-face classroom teaching.^[17] Majority of our students (60.70%) too felt that face-to-face teaching using demonstration techniques helped them to understand online video clips better than traditional practical sessions. They considered these online videos as useful tools to learn clinical skills related to injection techniques (93.10%).

Although we used online videos as resource material for reinforcing the traditional teaching method, they can be incorporated while adopting flipped classroom techniques in higher educational settings, wherein prior exposure of the students to the videos and resources can be used to support their skill learning during the class.^[4] Such an approach will help to enhance the analytical and problem-solving skills of the students as well.^[23,24] With competency-based undergraduate curriculum issued by MCI being implemented throughout India from August 2019 routes of drug administration is an essential skill and videos to supplementary tools to reinforce has also been introduced.

Limitations

We had only one mannequin in the Department of Pharmacology for the demonstration to the students as well as for conducting OSCE. It was, therefore, not possible to give practice to the students before they appear for OSCE, which would have strengthened the study. In addition, we had to limit to only 2 OSCE stations, of which only one can be kept for injection procedures. The design of the study was prospective single-arm instead of randomized controlled trials, which are considered as ideal for even few educational studies. However, with the intention that no student should miss this educational experience of online video and the possibility of contamination effect (students sharing online video link), the study was conducted as an open-label, single-arm study.^[25]

CONCLUSION

Thus, the present study illustrated that in pharmacology practical class, the procedural and communication skills relevant to the clinical practice can be taught, but this needs extra efforts by the teachers, especially those who teach in a resource-constraint setting. Although nothing can replace actual interaction with patients for the development of clinical skills, the use of online videos can be an effective modality to train in routes of drug administration, as opined by the students. Providing multiple learning experiences with online videos and designing an appropriate assessment plan can help the students to learn the skills and perform better in OSCE.

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Conflicts of interest

There are no conflicts of interest.

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