

Effectiveness Of Online, Offline, And Hybrid Teaching Approaches Amid Undergraduate Medical Students In Ophthalmology: An Observational Study

Running Title: Effectiveness of hybrid method of teaching in medical students

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ABSTRACT

Background:

The COVID-19 pandemic significantly disrupted educational systems worldwide and required medical institutions to rapidly shift to online teaching. Digital learning platforms enabled the continuation of academic activities during lockdown periods. However, concerns remain regarding the efficiency of online coaching when compared with classroom coaching, particularly in clinical disciplines where direct interaction and hands-on training are essential for skill development.

Objective:

The aim was to compare both online and offline teaching approaches amid undergraduate medical students studying ophthalmology. It also sought to evaluate students' preferences regarding incorporation of hybrid teaching approaches that involve both online and classroom-based teaching.

Methods:

An observational study was undertaken involving 110 third-year Phase-I undergraduate medical students. Selected ophthalmology topics were taught through both online teaching and offline teaching sessions. After the online sessions, students completed an online assessment using Google Forms. The same topics were later taught again through classroom sessions followed by an offline examination. Each assessment consisted of multiple-choice and short-answer questions with a maximum score of 25 marks. Students' perceptions regarding teaching methods were collected using an anonymous structured questionnaire containing ten items and open-ended responses. Quantitative analysis was carried out using descriptive statistical methods along with independent sample t-tests. Deductive content analysis was used for evaluating the responses obtained from open-ended questions to identify key themes.

Results:

The average score achieved in the offline examination was 14.9 ± 2.7 , while the average score in the online examination was 20.4 ± 3.2 , indicating a statistically significant difference ($p < 0.001$). Although students obtained higher marks in the online assessment, 53% reported referring to external resources during the online examination. In terms of learning preferences, the majority of participants (69.5%) favored traditional offline teaching. Meanwhile, 27.6% expressed preference for a hybrid learning model, whereas only 3.15% preferred fully online learning.

Conclusion:

Online learning played an important role in maintaining the continuity of medical education during the pandemic. Nevertheless, traditional classroom teaching continues to be crucial for student engagement, promoting interaction, and supporting the progress of clinical skills. The most effective model will be a hybrid approach that integrates both online lectures with offline in classroom clinical training sessions for undergrads.

Keywords: Hybrid learning, online teaching, medical undergraduates, ophthalmology education, blended learning

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Conflict of interest: None

INTRODUCTION

The COVID-19 pandemic disrupted educational systems across the world. In India, the initial first confirmed case of COVID-19 was registered on 30 January 2020. As the quantity of infected individuals increased, the Government of India stated a nationwide lockdown beginning on 24 March 2020. During this course of period, educational institutions and colleges were closed and conventional classroom teaching was suspended. To ensure that academic activities could continue, universities and medical colleges rapidly adopted online teaching methods. Video-conferencing tools, digital learning platforms, and virtual classrooms were commonly used for delivering lectures and conducting assessments.^{1,2} Although online learning allowed students to continue their studies and access learning resources remotely, a variety of obstacles were documented including technical problems, reduced interaction between teachers and students, and difficulty maintaining student engagement.³⁻⁵

Training in medicine does not only involve theoretical knowledge but also the strengthening of clinical skills and direct patient interaction. Practical demonstrations, clinical examinations, and case-based discussions form important components of undergraduate medical training and cannot be completely reproduced in a virtual learning environment.⁶ To overcome these limitations, blended or hybrid teaching models have been suggested as an alternative approach. Hybrid learning integrates online theoretical instruction with in-person classroom or clinical sessions, thereby combining the strengths of both teaching methods.⁷⁻⁹ The other researches in the literature has also indicated that hybrid learning may improve student participation and enhance learning outcomes in medical education.¹⁰⁻¹² Ophthalmology is a significant aspect of clinical subject within undergraduate medical education training that requires both conceptual understanding and practical skill development. Evaluating different teaching approaches in this discipline may help improve teaching strategies in medical education.

The present study aimed to assess the effectiveness of online and offline teaching methods utilized by students in undergraduate medical training studying ophthalmology and to assess students' perceptions regarding online, offline, and hybrid learning approaches.

METHODOLOGY

Study Design

The present study was designed as an observational study involving undergraduate medical students.

Study Participants

The study included 110 third-year Phase I undergraduate medical students from the 2018 batch.

Ethical Approval

Exempt review approval was obtained from the Institutional Ethics Committee, and the requirement for informed consent was waived.

Inclusion Criteria

Participants who attended both the online and offline teaching sessions, appeared for both examinations, and completed the feedback questionnaire were involved in the study.

Exclusion Criteria

The students who remained absent for either examination or who did failed to complete the questionnaire were excluded.

Teaching and Assessment Procedure

Selected ophthalmology topics were initially delivered through online teaching sessions using digital learning platforms. After completion of the online sessions, students completed an online assessment administered through Google Forms. The same topics were later taught again through offline classroom sessions conducted in the lecture hall. Following these sessions, students undertook an offline written examination. Both assessments had a highest possible score of 25 marks and consisted of an integration of multiple-choice questions and short-answer questions. The questionnaire was prepared by the investigator and reviewed for face validity by faculty members from the Department of Ophthalmology. The level of difficulty between the two assessments was maintained at a comparable standard.

Student Feedback Questionnaire

Students' perceptions regarding online and offline teaching were evaluated using a structured questionnaire consisting of ten questions. The questionnaire was completed anonymously to encourage honest responses. To obtain qualitative feedback regarding students' experiences open-ended questions were added. (Table 1).

Table 1. Questionnaire (structures and open ended)

Ques. no.	Asked Questions (n=105)	Categories	n(%)
1	Your overall experience on online lectures	Poor	35(33.3)
		Good	64(61.0)
		Excellent	6(5.7)
2	Do you have access to a device	Yes	73(69.5)
		No	32(30.5)

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	and network for online classes?		
		Yes, but it doesn't work at all times	30(28.5)
		No. I share with my siblings /parents	2(2.0)
3	The device used by you	Mobile phone	81(77.2)
		Laptop	15(14.3)
		Tablet	9(8.5)
4	How many hours of screen time was spent for online classes?	1-3hours	27(25.7)
		4-6 hours	65(62.0)
		7-10 hours	9(8.6)
		more than 10hours	4(3.7)
5	Was online classes helpful and effective?	not at all	13(12.3)
		slightly effective and helpful	40(38.1)
		moderately effective and helpful	41(39.1)
		Very helpful and effective	9(8.5)
		extremely helpful and effective	2(2)
6	Were the teachers helpful in solving your doubts during online classes	not at all	6(5.7)
		slightly effective and helpful	24(22.9)
		moderately effective and helpful	29(27.6)
		Very helpful and effective	35(33.3)

		extremely helpful and effective	11(10.5)
7	What were the challenges faced during online classes? (you may tick more than one option) (n=204)	Distraction from surrounding environment	67(32.8)
		Lack of internet and power supply	50(24.5)
		Technical issues regarding devices	54(26.5)
		Staying motivated	33(16.2)
8	Were you able to interact with your teachers during online classes	Occasionally	52(49.5)
		number of times	34(32.4)
		never	19(18.1)
9	Your performance during the online exams	casually answered all questions	24(22.9)
		honestly answer all questions with understanding	28(26.7)
		took the help of gadgets, opened books, took the help of friends	53(50.4)
10	Which method of learning will you prefer	Online	3(2.9)
		Offline	73(69.5)
		Hybrid	29(27.6)

Statistical Analysis

The analysis was carried out using Microsoft Excel and STATA version 14.2. Descriptive statistics were expressed as mean ± standard deviation and frequency percentages.

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The independent samples t-test was utilized to evaluate differences between the mean scores obtained in the online and offline assessments. Statistical significance was defined as a p-value below 0.05. Deductive content analysis was used to assess the qualitative responses to identify key themes such as concentration, distraction, motivation, interaction, and understanding were identified.

RESULTS

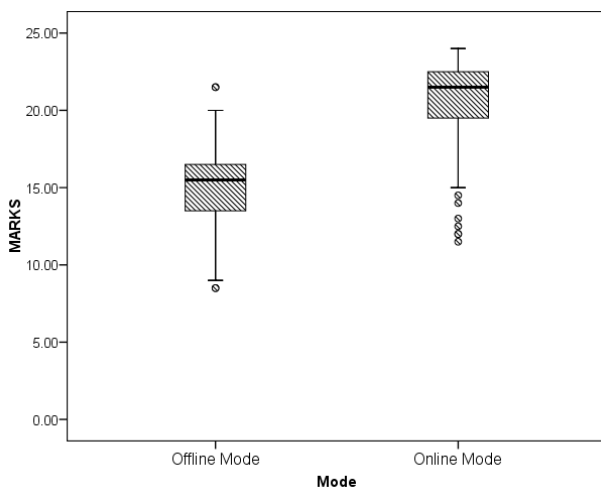
Comparison of Online and Offline Assessment

The mean score obtained in the offline examination was 14.9 ± 2.7 , whereas the mean score in the online examination was 20.4 ± 3.2 . A significant difference was found on statistical analysis between the two assessment methods ($p < 0.001$) (Table 2 and Graph 1).

Table 2. Comparison of Online and Offline Examination Scores

Assessment Mode	Mean Score \pm SD
Offline Mode (n=105)	14.9 (2.7)
Online Mode (n=110)	20.4 (3.2)
p-value	<0.001

Graph 1. Boxplot of marks (online vs offline)



Students' Perception of Online Teaching

Among the participants, 6% reported an excellent experience with online classes, while 64% described their experience as good. A small proportion of students reported a less satisfactory experience with online learning.

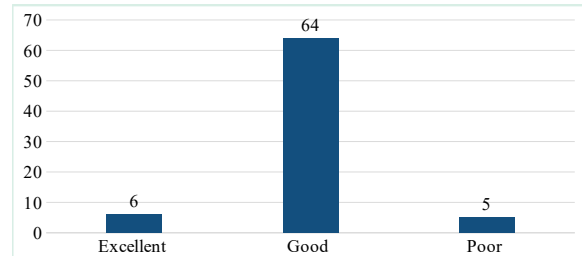
Preferred Teaching Method

Students' preferences regarding teaching methods are listed in Table 3.

Table 3. Student's Preference for Teaching Method

Teaching Method	Number of Students	Percentage
Offline	73	69.5%
Hybrid	29	27.6%
Online	3	3.15%

Graph 2. Student's perception of online/offline classes



Qualitative Feedback

The students who often preferred online classes pointed to the flexibility it provides. Many appreciated the convenience of attending classes from home and being able to utilize time more easily. Similarly, a considerable number of students felt that traditional classroom teaching offered certain advantages. They noted that face-to-face sessions made it easier to interact with teachers, stay attentive during lectures, and understand clinical topics more clearly. Some participants suggested that a hybrid format could be a practical solution. According to them, combining online lectures with in-person practical sessions would allow students to benefit from the flexibility of digital learning while still gaining the hands-on experience needed for clinical training.

DISCUSSION

The COVID-19 pandemic had forced educational institutions around the globe to rapidly adapt to online teaching sessions. Within a short time, many universities adopted digital platforms to continue academic activities during lockdowns. While this shift helped maintain the continuity of education, the overall effectiveness of online learning in medical training remains a topic of ongoing discussion.

In the present study, students obtained higher scores in online assessments compared with traditional offline examinations. In literature investigations with similar outcomes have been reported in research involving medical students.^{3,4} However, higher marks in online tests do not always reflect a core understanding of the subject. In the current study, almost half of the individuals acknowledged using external resources during online assessments, which may have influenced their performance.

Despite the growth of digital learning tools, classroom-based teaching continues to play an important role in medical education. Direct interaction between teachers and students encourages discussion, keeps students engaged,

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and allows immediate clarification of doubts. In clinical subjects such as ophthalmology, learning often involves observing examination techniques and understanding clinical signs. These practical aspects are difficult to demonstrate fully through online platforms alone.⁶

Recent studies indicated that the potential benefits of hybrid teaching approaches, where online learning is combined with traditional classroom sessions.

Blended learning combines online theoretical instruction with in-person classroom or clinical training and has been related to better learning outcomes and higher student satisfaction.^{7,10,11-13} Multiple investigations have similarly reported that students prefer hybrid learning models due to the flexibility while still allowing opportunities for practical clinical training.^{14,15}

Limitations and Clinical Implications

The present investigation has several limitations. The amount of offline teaching sessions was limited due to restrictions during the pandemic. Additionally, some students provided only brief responses in the qualitative feedback section. As the study was conducted at only one institution, the findings may be limited in the generalizability.

Even with these limitations, the outcomes of the study offered effective insights that could help guide improvements in teaching methods within medical education. The results suggest that a hybrid approach to teaching may be effective, as it brings together the flexibility of digital learning and the hands-on experience provided through classroom-based clinical training.

CONCLUSION

The present study explored the accuracy and effectiveness of online and offline teaching methods amid the undergrads pursuing their medical education, only ophthalmology subject was included. Although students tended to score higher in online assessments, most of them still expressed a preference for traditional classroom teaching. Many students felt that in-person sessions allowed better interaction with teachers, made them to stay more involved and focused during lectures, and made it easier to understand clinical concepts. These findings suggest that relying on only one mode of teaching may not fully meet the learning needs of medical students. A hybrid approach, which amalgamates online lectures with direct face-to-face clinical teaching, could therefore be a practical way forward. Such a model may allow students to benefit from the flexibility of online learning while still gaining the hands-on experience and interaction that are important for clinical training.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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