

Effectiveness of e-Learning during COVID-19 Pandemic among Under and Post Graduate Medical StudentsAjas SN¹, Chandra S Metgud²¹Senior Resident, Department of Community Medicine, Dr SMCSI Medical College & Hospital, Karakonam, Trivandrum, Kerala²Professor, Department of Community Medicine, KAHER, J N Medical College, Belagavi

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Conflict of interest: Nil

Abstract:**Background:** In the era of digital revolution and transformation, Medical Education has undergone an astonishing shift with the introduction of e-Learning, also known as Electronic Learning. Amid challenging situation like the COVID-19 pandemic, e-Learning has played a crucial role in ensuring the continuity of Medical Education without being hindered by prolonged lockdowns and closures.**Aim and Objective:** The aim of the study was to assess the effectiveness of e-Learning during COVID-19 pandemic among under and post graduate medical students, focusing mainly on their perception.**Materials and Methods:** A cross-sectional study was conducted utilizing a self-administered, semi structured questionnaire that went standardization by testing in 50 medical students. Upon obtaining Ethical Clearance from the Institutional Ethical Committee, the questionnaire was formatted into Google Forms and disseminated among medical students via social media channels. The study was carried out between 1st November 2020 to 31st January 2021. Responses from the participants were recorded for analysis. A total of 504 students took part in the study. The study evaluated various aspects including the demographic profile of the participant, their approachability to e-Learning Teaching Methods, perception and effectiveness of e-Learning, satisfaction towards e-Learning sessions, and their rating and preference of e-Learning methods. This comprehensive assessment aimed to provide insights into the impact and efficacy of e-Learning in medical education during unprecedented times.**Results:** The study, involving 504 students, revealed that the majority had the necessary equipment and Information & Technology skills for e-Learning participation. However, about half of the students encountered network issues during e-Learning sessions, posing a significant challenge. From the students' perspective, 95 respondents (18.8%) found e-Learning effective when compared to traditional classroom learning, while 151 (30.0%) rated their e-Learning experience during COVID-19 pandemic at >75% and 173 (34.0%) rated it below 50%. Despite these ratings, a significant majority (79.6%) preferred traditional classroom learning over e-Learning. Nonetheless, 160 students (31.7%) advocated for integrating e-Learning with traditional lectures, suggesting a potential hybrid approach. Substantial preference for e-Learning was noted among undergraduate students compared to postgraduate students (Odds Ratio 2.74, 95% Confidence Interval 1.75 to 4.30, p = <0.0001)**Conclusion:** These findings underscore the complexity of student preferences and highlight the need for tailored educational strategies to meet diverse learning needs effectively.**Keywords:** e-Learning, COVID-19, Medical Education.This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

In anticipation of the escalating threat posed by COVID-19, the Government of India implemented a pre-emptive measure by advising the suspension of classroom teaching across all educational Institutions. This directive presented a formidable challenge for the educational sector, particularly in specialized fields like Medical Education. Consequently, concerted efforts were initiated nationwide to migrate medical undergraduate

classes to e-Learning platforms. However, this transition encountered various obstacles, particularly in a developing country like India, where infrastructure and access to technology posed significant challenges. Nonetheless, amidst these challenges, the overarching objective persisted to maintain the continuity of education in the face of the unprecedented circumstances brought about by the pandemic. [1] e-Learning,

also called as Electronic Learning, refers to the use of electronic technologies to deliver education and facilitate learning outside of conventional traditional classroom settings. It has a wide range of digital resources and platforms, including online courses, interactive multimedia, virtual classrooms, and educational apps. e-Learning provides learners with flexibility and convenience, allowing them to access materials and engage in learning activities at their own pace and on their preferred devices, such as computers, tablets, or smartphones. Utilizing a variety of virtual platforms such as Zoom, Google Meet, and other interactive software, Medical Education has transitioned seamlessly into the digital realm. [2]

During the COVID-19 pandemic, both undergraduate and postgraduate medical students have heavily relied on e-Learning to sustain their education. Undergraduate students have leveraged e-Learning platforms to attend virtual lectures, access course materials, and engage in collaborative group projects remotely. Similarly, postgraduate students have utilized e-Learning for more specialized studies, conducting research, accessing advanced course materials, and participating in online classes, seminars, and conferences.

e-Learning in India faces several challenges like lack of access to reliable internet networks, inadequate infrastructure particularly in rural areas and so on. Also, many faculties, especially seniors lack the necessary Information & Technology (IT) skills and training to effectively deliver e-Learning content. Lack of an effective assessment methods or tools for e-Learning environments could also be challenging. Keeping that in mind, we conducted a cross-sectional study with the aim of evaluating the

effectiveness of e-Learning during the COVID-19 pandemic among both undergraduate and postgraduate medical students, by focussing on their perception of this educational approach.

Objective:

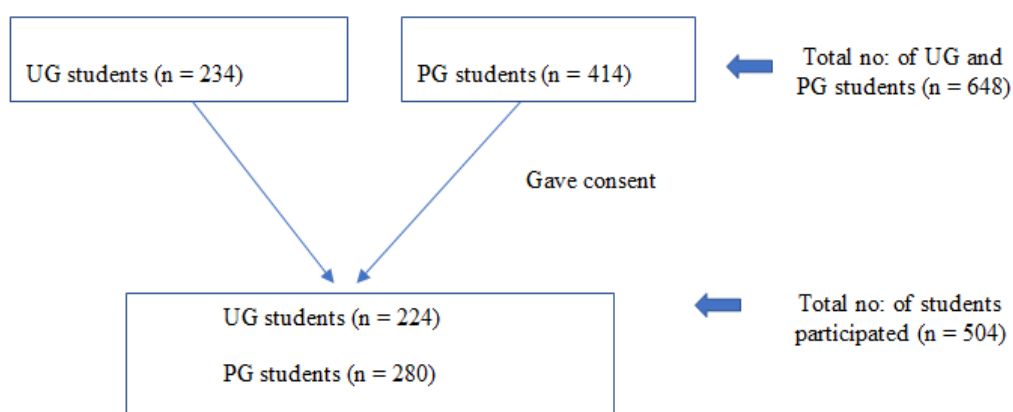
To assess the effectiveness of e-Learning during COVID-19 pandemic among both undergraduate and postgraduate medical students

Materials and Methods

A Cross - sectional study was conducted among undergraduates (UG) and postgraduate (PG) medical students of KAHER, J N Medical College Belagavi, and Karnataka from 1st November 2020 to 31st January 2021.

Study initially aimed to include 648 medical students of KAHER, J N Medical College Belagavi, Karnataka, but ultimately received responses from 504 participants, resulting in a response rate of 77.8%. Study participants included MBBS Phase III Part-I undergraduates and postgraduate students from 1st, 2nd, and 3rd year. A universal sampling method was employed to select study participants. A self-administered, semi structured questionnaire which was standardized with a sample of 50 students, was used for data collection. Following Institutional Ethical Clearance, the questionnaire was converted into Google Forms and distributed to medical students through social media platforms. Students who gave consent for the study after reading information sheets were given access to fill the questionnaire. Exclusion criteria were applied to students who were not willing to participate.

Details of study Participants:



The non-response rate was slightly higher (4.3% vs 32.4%) among postgraduate students. The questionnaire includes the following sections

1. Demographic profile of the study participants
2. Approachability to e-Learning Teaching methods

3. Perception and effectiveness of e-Learning
4. Satisfaction towards e-Learning sessions
5. Rating and preference of e-Learning method.

To gather data on perception, effectiveness, and satisfaction with e-Learning sessions, 5-point Likert scale questionnaires were employed.

Collected data was entered into Microsoft excel, and analysed with the help of Google forms, Microsoft excel & SPSS (trial version 26.0). Statistical methods used were percentages for qualitative data and mean \pm SD for quantitative data respectively. For association of variables Pearson Chi-square test was used.

Results

In our study, there were 504 participants, with 262 (52.0%) being male and 242 (48.0%) female. Regarding age distribution, 234 (46.4%) were aged between 20 and 25 years, 171 (33.9%) 26 to 30 years, 91 (18.1%) 31 to 35 years and 8 (1.6%) were aged more than 36 years. The mean age of the participants was 26.2 years, with a standard deviation of 4.5 years. Out of 280 postgraduate students, 108 (38.6%) were in their 2nd year, followed by 101 (36.1%) in their 1st year and 71 (25.3%) in their 3rd year. Approachability to e-Learning Teaching Methods: Majority of participants 433 (85.9%) possessed adequate equipment such as laptop and smartphone for engaging in e-Learning sessions. Conversely, a smaller group, comprising of 27 (5.4%) reported a lack of sufficient facilities like internet access or necessary software. Additionally, more than 3/4th

of the respondents (83.3%) demonstrated sufficient IT skills to effectively manage e-Learning sessions. Smartphone emerged as the most utilized mode for e-Learning with 335 students (66.5%) favouring this device. Moreover, over half of the respondents, 253 (50.2%) had prior experience with e-Learning before the COVID-19 pandemic.

Furthermore, a significant majority 439 (87.1%), exhibited familiarity with the tools commonly employed in e-Learning, such as Zoom, GoToMeeting, Google Classroom and Google Meet. Regarding the frequency of e-Learning sessions, approximately 124 (55.4%) undergraduate students were engaged in three classes of e-Learning sessions per day. Notably, the duration of e-Learning sessions per day varied across departments, contingent upon the practical sessions.

Among postgraduate students, 179 (63.9%) dedicated three hours per week to e-Learning sessions. The duration of teaching hours varied according to type of learning (seminar, journal article or case presentation). However, around 176 (34.9%) expressed concerns regarding the feasibility of e-Learning due to time constraints, potentially impacting its effectiveness (Table 1).

Table 1: Approachability to e-Learning Teaching Methods among study participants

Particular	Number	Percentage
Mode of Accessing e-Learning		
Smartphone	335	66.5
Laptop	107	21.2
Tablet / iPad	57	11.3
Desktop	5	1.0
Number of classes per day for UG student (n = 224)		
One	22	9.8
Two	31	13.8
Three	124	55.4
Four	37	16.5
> Four	10	4.5
Teaching Hours per week for PG student (n = 280)		
One	20	7.1
Two	45	16.1
Three	179	63.9
Four	36	12.9

The foremost issue preventing students from attending e-Learning sessions, cited by 255 (50.6%) of respondents, was attributed to bad internet connectivity and network issues (Figure 1).

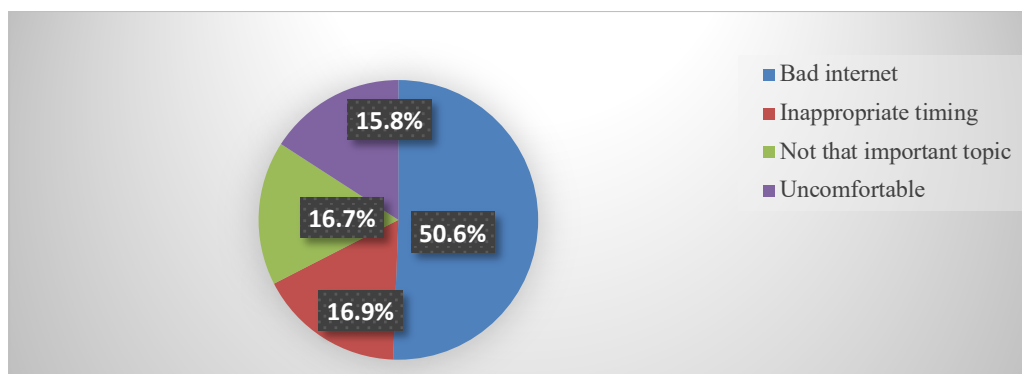


Figure 1: Problems for not attending e-Learning sessions

Perception and effectiveness of e-Learning among study participants:

Regarding perception of e-Learning, 274 (54.4%) of students perceived that web-based teaching learning was need of the hour, 352 (69.8%) thought it as valuable during COVID-19 lockdown period, 360 (71.5%) thought e-Learning tools are easy to use and 281 (55.8%) perceived that home was an ideal environment for e-Learning. With regards to effectiveness of e-Learning, 291 (57.7%) of students were able to enhance the subject

knowledge and 250 (49.7%) were able to acquire skill.

Whereas 280 (55.5%) students found that e-Learning was difficult than classroom teaching, only 95 (18.8%) agreed that online lecture are effective compared to traditional / live classroom lecture and 325 (64.5%) were ready for hybrid mode of teaching (continuation of e-Learning sessions alongside traditional classroom learning) (Table 2).

Table 2: Perception and effectiveness of e-Learning among study participants

Particulars	Strongly disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly agree n (%)
Web-based teaching is important for a student	21 (4.2)	38 (7.5)	171 (33.9)	230 (45.7)	44 (8.7)
e-Learning makes lockdown time a useful one	23 (4.6)	24 (4.8)	105 (20.8)	256 (50.8)	96 (19.0)
e-Learning improves knowledge	26 (5.2)	48 (9.5)	139 (27.6)	228 (45.2)	63 (12.5)
e-Learning helps to acquire skill	40 (7.9)	95 (18.8)	119 (23.6)	205 (40.8)	45 (8.9)
e-Learning tools are easy to use	9 (1.8)	38 (7.5)	97 (19.2)	281 (55.8)	79 (15.7)
e-Learning are difficult than classroom teaching	29 (5.8)	105 (20.8)	90 (17.9)	210 (41.6)	70 (13.9)
Home environment is suitable for participation in online lecture	45 (8.9)	70 (13.9)	108 (21.4)	214 (42.5)	67 (13.3)
Online lecture are effective than traditional / live classroom lecture	136 (27.0)	147 (29.2)	126 (25.0)	60 (11.9)	35 (6.9)
Keep online learning along with traditional classroom learning	31 (6.2)	45 (8.9)	103 (20.4)	165 (32.8)	160 (31.7)

Satisfaction towards e-Learning sessions among study participants: Out of 504 students, 332 (65.9%) expressed a positive inclination and 335 (66.5%) had interest in e-Learning sessions. Despite the good user-friendliness of the software (82.5%) and the provision of proper guidelines and links before commencing e-Learning sessions (70.2%), more than half of the participants encountered one or the other issues during the sessions. Although the students were satisfied with study material (65.6%) provided to them, however

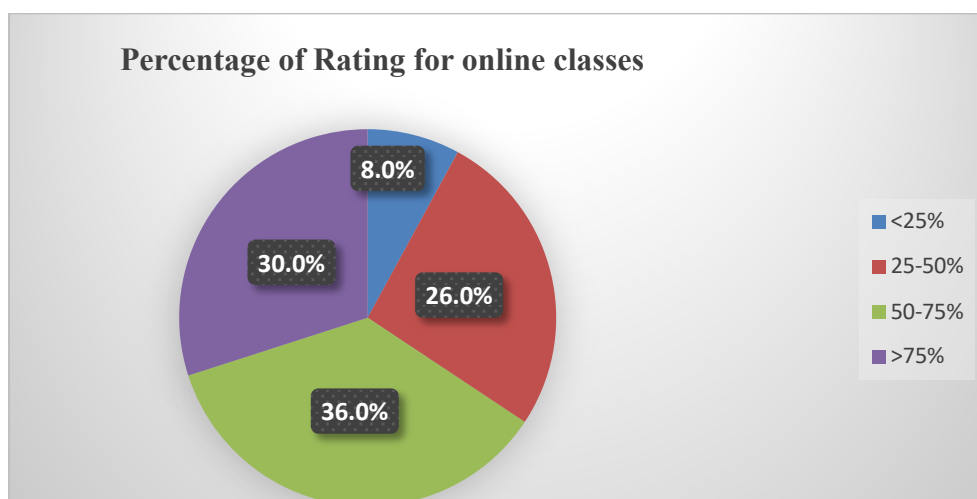
they missed the communication process (56.8%) and personal attention (59.3%) given to them by faculty during traditional classes. Moreover, nearly 13.9% of participants experienced vision-related problems after e-Learning sessions, indicating a need for consideration in future sessions. Additionally, a small percentage (5%) of students expressed dissatisfaction with online teaching methods and study materials, which could potentially affect the effectiveness of e-Learning among study participants. (Table 3)

Table 3: Satisfaction towards e-Learning sessions among study participants

Particular	1	2	3	4	5
	n (%)	n (%)	n (%)	n (%)	n (%)
Positive inclination towards e-Learning*	20 (4.0)	99 (19.6)	53 (10.5)	186 (36.9)	146 (29.0)
Interested towards e-Learning*	26 (5.2)	102 (20.2)	41 (8.1)	179 (35.5)	156 (31.0)
Sincerity level of the attendees for online class*	25 (5.0)	102 (20.2)	48 (9.5)	177 (35.1)	152 (30.2)
User-friendliness of the software used for e-Learning*	6 (1.2)	30 (6.0)	52 (10.3)	241 (47.8)	175 (34.7)
Guidelines / Links are provided before starting online class**	28 (5.6)	44 (8.7)	78 (15.5)	127 (25.2)	227 (45.0)
Inconsistent / poor communication with the faculty**	26 (5.2)	80 (15.9)	112 (22.1)	211 (41.9)	75 (14.9)
Encountered vision-related problems after online class started**	68 (13.6)	100 (19.8)	100 (19.8)	166 (32.9)	70 (13.9)
Faculty's personal attention and touch are less**	41 (8.1)	83 (16.5)	81 (16.1)	182 (36.1)	117 (23.2)
Happy about online teaching methods and study materials*	25 (5.0)	75 (14.9)	73 (14.5)	171 (33.9)	160 (31.7)
Gained experience of learning in a new online environment*	11 (2.2)	32 (6.3)	48 (9.5)	205 (40.7)	208 (41.3)

*1 – Not at all, 5 – very much, **1 – Never, 5 – Almost always

Rating and preference of e-Learning Method: Students who rated their e-Learning experience more than 75% was considered as a good rating. About 151 respondents (30.0%) rated their experience as more than 75%, indicating a positive rating. However, a notable portion, 173 individuals (34.0%), rated their experience below 50% (Figure 2). However, a significant majority, 79.6% of respondents, expressed a preference for traditional conventional classroom learning over e-Learning. (Figure 2)

**Figure 2: Percentage of Rating for online classes**

The inclination toward e-Learning over traditional classroom learning was notably higher among undergraduate students, with 66 (29.5%) expressing a preference, in contrast to postgraduate students, where 37 (13.2%) favoured it. This observed contrast was statistically significant (Odds Ratio 2.74, 95% Confidence Interval 1.75 to 4.30, $p = <0.0001$). These findings imply a notable preference for e-Learning among undergraduate students in comparison to postgraduate students.

Among the students who had prior experience with online teaching before the COVID-19 pandemic, 62 individuals (24.5%) found e-Learning to be more effective than classroom learning. This disparity was statistically significant (Odds Ratio 2.71, 95% Confidence Interval 1.35 to 3.41, $p = <0.001$).

Discussion

e-Learning has been crucial in Medical Education during the COVID-19 pandemic, maintaining learning continuity while following safety guidelines and social distancing protocols. Medical Institutions globally quickly shifted to online platforms for delivering lectures, seminars and practical training. This transition allowed medical students to pursue their education seamlessly, while also reducing the risk of exposure to the virus. [3] This study aimed to assess the effectiveness of e-Learning among both under and postgraduate medical students during the COVID-19 pandemic, particularly in a resource-limited developing country such as India.

Most participants, 85.9% had access to adequate equipment such as laptop and smartphone, which may be affordable options for medical students, enabling them to engage in e-Learning sessions. Smartphone (66.5%) emerged as the most utilized mode for e-Learning which could be due to their convenience and ease of use. Our findings were almost similar to the study conducted by Adhikari, et al. [2].

More than half of the students (58.4%) encountered issues during e-Learning process, including inconsistent contact and communication during the sessions. This finding aligns with similar observations reported by Rishi et al. [1] Furthermore, nearly 56.8% of participants experienced vision-related problems after e-Learning sessions, which is consistent with the findings of a study done by Desai et al. [4], where approximately 55% of participants reported eye strain and discomfort which could be due to increased screen time. These vision-related issues could warrant serious consideration if e-Learning continues to be the primary mode of education. More than fifty percent of the students noted poor communication process with their faculty, along with a perceived lack of personal attention and engagement. One potential solution to address this concern could involve providing training and workshop sessions for the faculty to conduct e-learning sessions effectively.

A significant portion 79.6% of respondents expressed a preference for traditional classroom learning over e-Learning, citing the problems encountered with e-Learning. However, 31.7% advocated for the continuation of e-Learning sessions alongside traditional classroom learning, which echoes findings from a study conducted by Sindiani et al [5], where 42% of students preferred integrating e-Learning with traditional learning.

In summary, although students faced various challenges with e-Learning, there is a portion advocating for its integration with traditional classroom learning, suggesting a hybrid approach

which can accommodate diverse learning styles and preferences, providing students with more options for accessing educational content and resources.

Limitations: Using the same questionnaires for both under and postgraduate students may have introduced bias due to the considerable differences in curriculum and class dynamics. Adding to it, ideally, a comparison of the effectiveness of e-Learning with traditional classroom learning could have been conducted. However, due to the on-going pandemic, traditional classroom learning had been suspended, making it challenging to directly compare the two modes of education. These limitations should be acknowledged in our study, as it affects the generalizability and the ability to draw definitive conclusions about the relative effectiveness of e-Learning compared to traditional classroom learning.

Conclusion

Amidst the COVID-19 pandemic, e-Learning has been instrumental in maintaining educational continuity for medical students. Nonetheless, in resource-constrained settings like ours, several challenges in virtual learning must be addressed. In order to effectively facilitate e-learning sessions, faculty require a blend of technical expertise, pedagogical understanding, and proficiency with e-learning platforms, which necessitates training. Introducing a potential hybrid approach could also prove beneficial, as it prepares us for future pandemics or health crisis that may necessitate a return to e-Learning. Evaluating the effectiveness and utility of e-Learning among students through further research is crucial. Such assessments will offer valuable insights for refining e-Learning strategies to better cater to the requirements of medical education in our setting.

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