
EFFECT OF COVID-19 ON MEDICAL EDUCATION IN PAKISTAN – PERCEPTION OF MEDICAL STUDENTS: A CROSS-SECTIONAL SURVEY

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ABSTRACT

Covid-19 has created a long-lasting impact on our pattern of life. Our daily routines have been altered; offices, business, education, and even social culture have been affected to such an extent that new ways were created to adjust to COVID-19 threats. This threat created difficulties for interaction between people and we were forced to adopt remote working procedures, online earning, and online shopping. Similarly, travel restrictions, lockdowns, and social interactions among close family members were also hit. Although these measures managed to control disease, many still lost their lives and others suffered economic losses of millions. But at the same time, COVID-19 brought the wearing of masks, utilizing hand sanitizers, focusing on personnel hygiene, repeated washing of hands, adopting physical distance between individuals' social interactions, etc. Similarly, more frequent use of digital technologies, a culture of virtual meetings & remote offices, online education & examination systems were adopted to address the challenges of COVID-19. These measures have been adopted as permanent in our way of life even when COVID-19 is a bare minimum threat. The education sector at the global level also felt severe jolts

because of COVID-19, as teacher-student physical interaction, availability of classroom instructions, laboratories, models, library, group discussions, and central examination systems were all reduced to a bare minimum. Lower classes up to high school were promoted without exams and assessments. University-level education especially sciences faculties (medicine and engineering) got a severe hit compared to other social sciences subjects. Medical and Engineering faculties were forced to utilize innovative methods (without physical interactions) for imparting technical education. This paper focuses on the impact of COVID-19 on medical education in Pakistan. The primary data was collected through interviews and surveys across the medical institutions of Islamabad and Rawalpindi and analyzed. The overall findings were also compared to global trends in medical education adopted worldwide. Teachers' & Students' observations and their perceptions about the quality loss incurred during the COVID period are the main arguments. The findings of the study suggest that both teachers and students were of the view that medical education suffered due to the adoption of COVID-19 restrictions and the denial of on-campus education. This has resulted immensely in their professional development, both in knowledge, medical ethics & approach while dealing with patients. The time lost during this period, void of interaction between teachers, students, and patients cannot be covered and doctors of this era will need extra effort to overcome their shortcomings during their professional careers. The research provides an in-depth analysis of the total impact of COVID on medical education in Pakistan and suggests the way forward for the future.

KEYWORDS

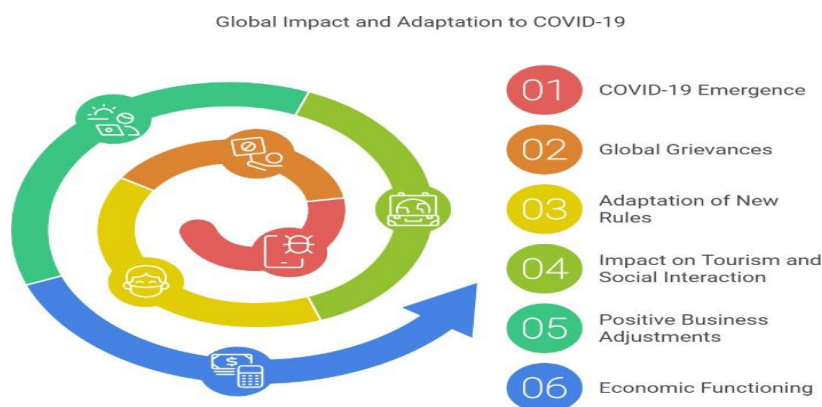
COVID-19, Medical Education, Impact, Distance Learning, Professional Development

INTRODUCTION

COVID-19, AKA the novel coronavirus, has caused considerable grievances and a global pandemic in the year 2020, leaving more than 704,753,890 people affected and 7,010,681 dead by 13 April 2024 (COVID - Coronavirus Statistics - Worldometer, 2024). All that forced the world to adapt to a newfound way of life, regardless of the discomfort the new rules bring.

Among these were wearing a mask in public spaces, avoiding physical contact with others, practicing social distancing (at least 6ft. necessary), citywide lockdowns, travel restrictions, halting of in-person classes in schools and other educational institutions, and banning of large gatherings all over the world to avoid spread. Global Tourism and social interaction between people got the worst hit by COVID-19. On the other hand, the World also adjusted to this menace in some positive ways. The business world adjusted by exploiting the computer world to the maximum, reducing the

requirement of physical office and attendance thus decreasing overhead costs. Online business mushroomed even in Third World countries, and even small traders got some share of the pie. This allowed the world economies to function even in a worse era of known history.



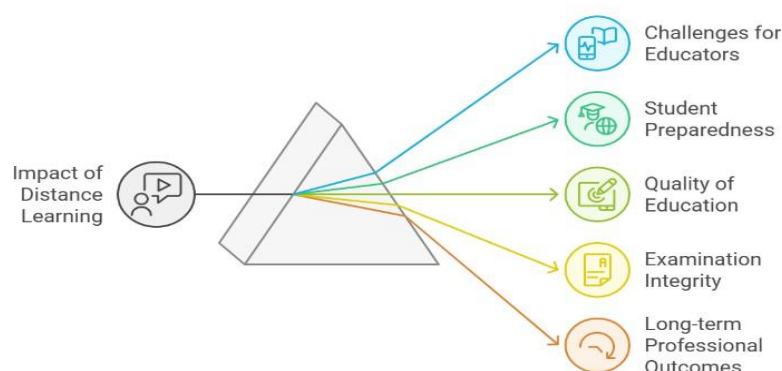
Impact on the Education System

Another major impact seen was on the education sector, which was managed through distance learning. Most of the global training institutions, including globally acclaimed universities, discontinued campus education and shifted their focus to alternate methods including distance or e-learning. This forced adoption of online teaching methods was equally difficult for educators, students, and institutions. Moreover, they were not mentally prepared as well and not well-equipped to undertake such an education. Unfortunately, this also reduced the teacher-student interaction which resulted in compromising the quality of education. The education system also got a major hit because of online methods of examinations as well as assessment.

This also resulted in a free ride for weak individuals to qualify on a gratis basis without undergoing rigorous examination systems. Even students up to A level were promoted to the next higher grades in the absence of centuries-old examination systems. Online teaching brought many challenges for educators but had a long-term effect on the overall quality of output, i.e., producing quality professionals (Dayal, 2023).

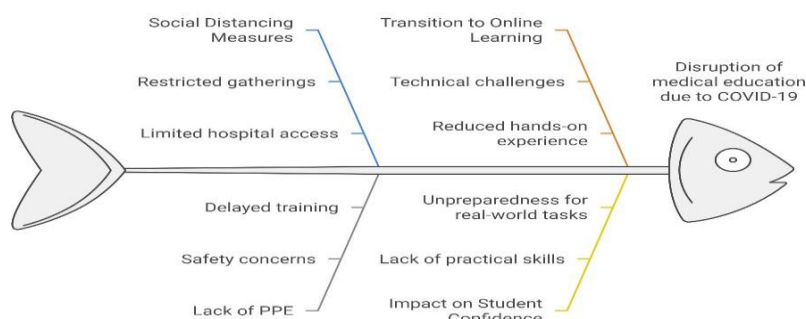
These effects cannot be measured or gauged in the immediate time; however, experts are of the view that a marked difference will be observed in times to come in these professionals' output viz-a-viz their counterparts of previous years. But they also believe that such individuals will have the chance to enhance their knowledge later as well as learn from their mistakes. But their mistakes, erroneous observations, and weak decision-making will not directly play or hurt humans. Their collective wisdom will overcome their shortcomings, if any.

Unpacking the Impact of Distance Learning



The impact of COVID-19 on imparting worldwide medical education to prospective doctors has been significant.¹ Medical students have also been affected likewise in all aspects of their learning experience. Medical education requires classroom instructions and on-the-job training, i.e., dealing with an actual patient (sometimes on dead bodies and models). Moreover, students do require laboratories and physical presence in hospitals to clarify their concepts under the watchful eyes of their instructors. It is worthwhile to mention that medical education requires a 100% understanding of the full human body as well as its treatment. Nothing can be left to chance or medical students do not have the luxury of skipping a few chapters; thereby opting for a selective study of the subject. Similarly, social distancing, being the most important preventive measure, precluded students from gathering in learning studios, lecture halls, or small-group rooms (Choi et al., 2020).

Challenges in Medical Education During COVID-19



All this is because the highly contagious coronavirus could have unknowingly been contracted and transmitted in classes and hospitals alike. Initially, at the start of the outbreaks, students were quickly removed from hospitals, owing to the lack of masks & PPE. At that time, knowledge about the then-unknown nature of the virus was

limited, and remedial measures were unknown. Even, the Association of American Medical Colleges (AAMC) also halted all forms of medical education for the safety of students (Medical Student Education in the Time of COVID-19 | Medical Education and Training | JAMA | JAMA Network, 2020). The study carried out on medical residents proposed no alternative to OJTs, but options of distance learning, computer-based simulations, and surgical videos were considered as a replacement to save time as well as better than nothing (Updated Interim Guidance for Medical Students' Participation in Patient Care During the Coronavirus (COVID-19) Outbreak, 2020).

This separation of students from regular medical training was also important against the backdrop that no known medication then exists to treat the COVID-19 patient. However, it was observed through various global studies pointed out that the impact of COVID-19 on medical student education was assessed to be significant, particularly affecting the 4th and 5th years students during their transition to doctor. Furthermore, studies also pointed out the negative impact of online/distance learning medical education on their confidence and preparedness to independently handle medical situations (Chick et al., 2020).

LITERATURE REVIEW

The COVID-19 pandemic drastically altered the landscape of medical education, prompting a shift from traditional in-person learning to online platforms. This review aims to synthesize findings from various studies to understand the extent and implications of this transition; Before the pandemic, medical students spent an average of 4.75 hours per week studying online. However, this figure increased to 12.15 hours per week during the pandemic. A study in the UK presented a significant rise in the number of students spending more than 15 hours online, from 7.35% pre-covid to 23.5% during the pandemic (Impact of COVID-19 Pandemic on Online Medical Education - An Online Survey of Students' Perspective - PubMed, 2024). The increase in online study hours ($p < 0.001$) can be attributed to the shift in instructional methods. However, it is important to note that the usage of basic sciences and clinical students were not compared individually, which is a limitation of the data.

Furthermore, students from government sector institutions spent more hours per week on average (5.78) compared to those from private sector institutions (4.49). This pattern might be skewed due to the disproportionate sampling group, with 79.8% of responses from private medical colleges. In a similar study from Kerala, India, 82.3% of respondents were from private colleges, with government colleges lagging due to delayed online education during the pandemic (Impact of COVID-19 Pandemic on Online Medical Education - An Online Survey of Students' Perspective - PubMed, 2024). A majority of respondents (77.5%) preferred online video tutorials, such as YouTube and Osmosis, due to their convenience and multiple visits. Live tutorials,

were less favored due to time restrictions and connectivity issues.

Despite the convenience of online learning, many students expressed a preference for offline, in-person teaching, pointing out better opportunities for interaction. The average score for online learning experience was 3.51 out of 5, indicating a desire for more interactive online sessions. Platforms like WhatsApp have been of immense importance in facilitating effective communication and management between instructors and students. This method ensures clarity in understanding and makes the learning environment more dynamic and enjoyable (Ohara, 2023).

The sudden shift from Classroom teaching to e-learning resulted in several challenges, including technical difficulties, connectivity issues, and unfamiliarity with online teaching methods. The underdeveloped curriculum, lack of computer skills among professors, and inadequate preparation of institutions led to significant dissatisfaction (The Sudden Transition to Online Learning: Teachers' Experiences of Teaching during the COVID-19 Pandemic | PLOS ONE, 2023).

Students expressed hesitancy with their professional competence, with 35.8% of respondents showing a lack of confidence in their preparation to become good doctors. The halt of clinical attachments and minimal interaction with patients have put students at a disadvantage. In contrast, a study in France cited a strong desire among students regarding online teaching during the pandemic (89% response in favor) (A Systematic Review of Health Sciences Students' Online Learning during the COVID-19 Pandemic | BMC Medical Education | Full Text, 2022).

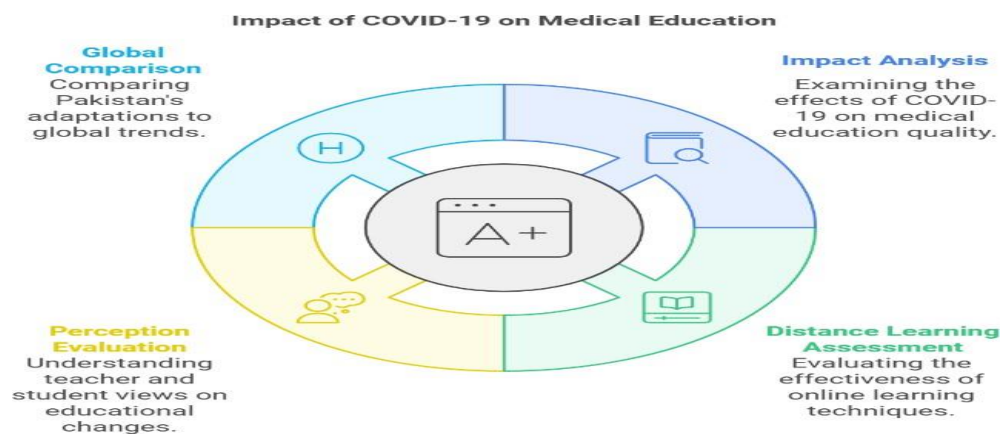
The majority of students (86.87%) reported that their examinations were negatively affected, with 70% stating their written exams and 59.93% stating their practical exams were postponed. This led to delays in completing the syllabus within the scheduled time, adversely affecting the curriculum schedule. Even though there were a number of drawbacks, Online learning had its benefits: such as being economical, flexible and saving travel time. Some students preferred the anonymity of online interactions, making the learning experience less intimidating (Students' Experience of Online Learning during the COVID-19 Pandemic: A Province-wide Survey Study - PMC, 2021). However, a study from India found that out of 201 planned e-learning sessions, 82 were canceled due to technical reasons or the unavailability of the presenter (Medical Students' Perception towards E-Learning during COVID-19 Pandemic in a High Burden Developing Country | BMC Medical Education | Full Text, 2021).

The most effective method of online teaching was found to be video tutorials, with a 77.52% preference for Zoom/Meet lectures in the study population. Differences in

preferences were noted compared to studies in the UK, Japan, Malaysia, and France. The lack of good infrastructure and technologically competent staff in Pakistan pre-lockdown times contributed to challenges in online teaching. In China, teachers were disheartened to teach online due to a lack of skills (Camille Gardner & Henry, 2021). The study found that 51.8% of respondents strongly disagreed that online teaching is equivalent to face-to-face learning. Similarly, 35.8% strongly disagreed that they were being adequately prepared for their professional years ahead. This contrasted with a study in Morocco, where 79% of students appreciated the role of online education in Medicine. Government sector students used e-teaching facilities better than private sector students before the pandemic. A Man-Whitney U test found a significant difference in time spent on online platforms by government and private students before COVID-19 ($p=0.028$). During COVID-19, the difference was insignificant.

RESEARCH OBJECTIVES

1. To analyze the impact of COVID-19 on the quality of medical education in Pakistan, particularly in Islamabad and Rawalpindi regions.
2. To assess the effectiveness of distance learning techniques on medical education (using computer graphics and online lectures) used by medical institutions during the COVID-19 pandemic.
3. To evaluate the perceptions of teachers and students regarding the loss of hands-on experience and professional development in medical education due to COVID-19 restrictions.
4. To compare the adaptations in medical education in Pakistan with global trends and suggest strategies for future preparedness.



RESEARCH HYPOTHESES

1. There is a significant difference in medical student learning outcomes between online and traditional classroom learning techniques.

2. There is no significant difference in medical student learning outcomes between online and traditional classroom learning techniques.

RESEARCH QUESTION

1. What impact did COVID-19 have on medical education, specifically in terms of transition to online learning platforms?

RESEARCH METHODOLOGY

The research methodology adopted was the hybrid model of both qualitative and quantitative techniques. The design of the study is based on the cross-sectional analysis of the web-based study model. The group of doctors and medical students was involved in carrying out data collection to find the actual loss of medical education. For sampling, the inclusion criteria opted was to induct volunteer medical students of public and private colleges in Islamabad. The study period was time-limited, i.e. 03 months after IRB approval and focused on the year 2020.

The data was collected by a self-administered survey & questionnaire and was disseminated to medical students online. To prevent multiple entries, participants were required to sign in using their email accounts. Student participation was voluntary and anonymous. The pilot web survey was conducted among 5 randomly selected medical students to assess clarity, relevance, and acceptability. Changes were made accordingly. These participants were included in the research. The survey was disseminated by posting a link to the survey with an accompanying paragraph (about the objectives of the study) on WhatsApp groups and email accounts of medical students. During the distribution of the survey to potential respondents, they were informed that by completing the survey, they would be providing consent for their anonymized data to be used, analyzed, and potentially published.

The obtained data was analyzed using SPSS version 24 (IBM). Descriptive analysis was applied to calculate frequencies and proportions. The chi-square test was used to investigate the level of association among variables. A P value of less than 0.05 was considered statistically significant. On the other hand, the reality was that 70.03% of the written and 59.93% of practical examinations were postponed. Moreover, practical exams conducted online were around 12.05%, whereas only 9.12% of written exams were held (Pie Charts 2 -4).

DATA ANALYSIS AND RESULTS

Demographics Survey Details

A total of 307 responses were collected, out of which 59.3% (n=182) of respondents were women, and 40.7% (n=125) were men.

Gender	Proportion of Students n (%)
Male	125 (40.7%)
Female	182 (59.3%)
Total	307

(Table – 1)

A total of 79.8% of responses were collected from students at private medical colleges and 20.2% from government colleges (Table – 2).

Sector	Proportion of Students n (%)
Government Medical Colleges	62 (20.2%)
Private Medical Colleges	245 (79.8%)
Total	307

(Table – 2)

The study was primarily planned for 4th and 5th years of loss of quality medical education; however, sampling was made across all years. Results indicate that 4th-year students responded the most, i.e. 40.45% (n=24) (Table 3).

Year	No. & Percentage
1 ST YEAR	44 (14.3%)
2 ND YEAR	53 (17.3%)
3 RD YEAR	57 (18.6%)
4 TH YEAR	124 (40.45%)
5 TH YEAR	29 (9.4%)

(Table – 3)

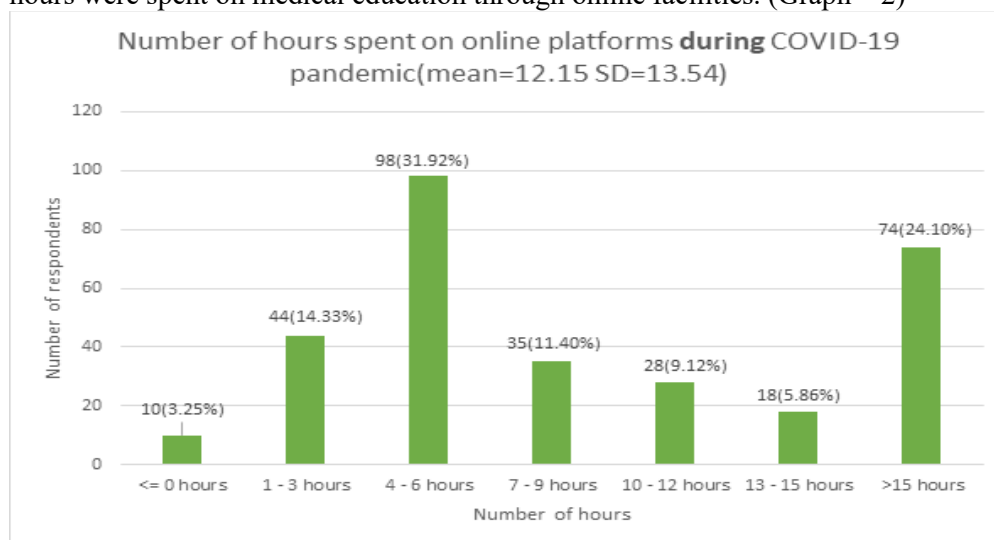
Student engagement with online teaching platforms before the pandemic

In reply to a question regarding students utilizing online teaching facilities before COVID-19, it was revealed that students spent an average of 4.75 hours per week using online teaching platforms (Graph - 1).

Time spent during the COVID period on online methods of Education.

Another sample was taken to understand the time spent during the COVID period on

online methods of education. The survey reveals that an average of more than 12.15 hours were spent on medical education through online facilities. (Graph – 2)

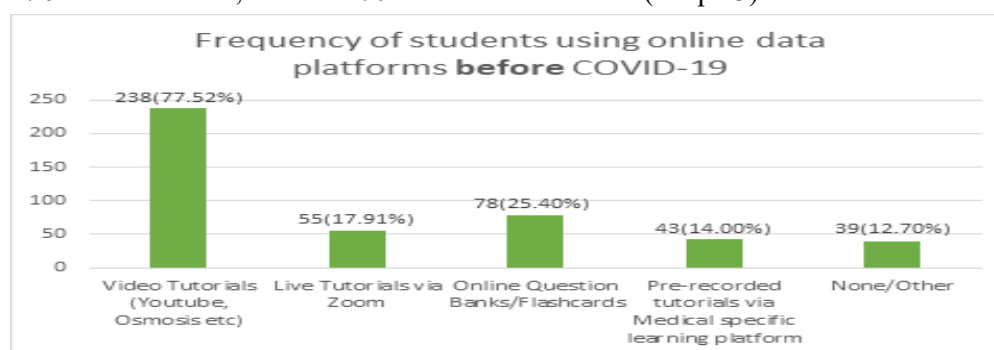


(Graph 2)

Deduction: One sample t-test was conducted which found the difference between graphs 1 & 2 to be significant ($p < 0.001$).

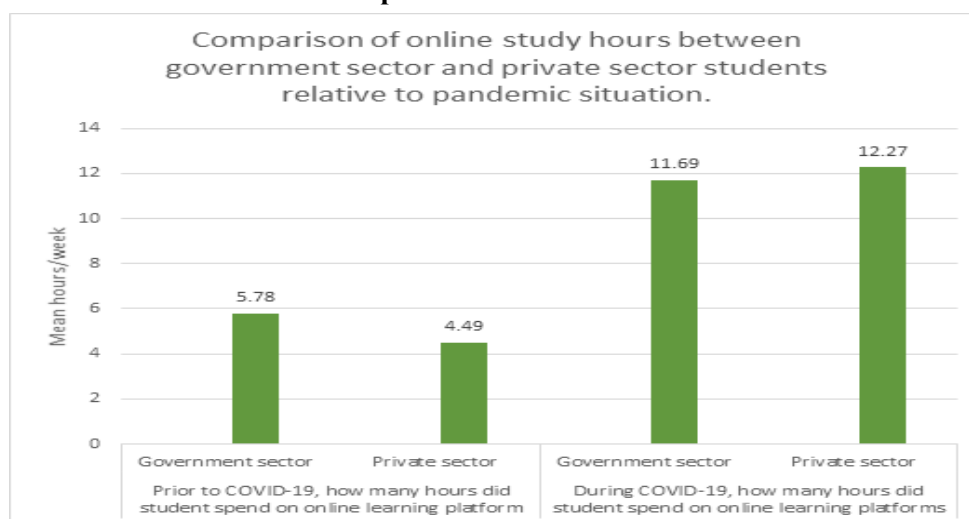
Use of Online Data before COVID

On inquiry about the various options of utilizing online tutorials, the result of the survey indicates that students opted for a combination of various options including video tutorials (77.52%), pre-recorded tutorials via medical-specific learning platforms (14.00%), and online flashcards (25.40%). Live tutorials via Zoom were used by 17.91% of students, while 12.70% used other sources (Graph 3).



(Graph – 3)

Comparison of online study hours between situations. Government and Private Sector students relative to the pandemic situation



(Graph – 4)

Indicates that on an average student from government sector medical colleges spent an average of 5.78 hours on online learning platforms, whereas students.

Private colleges spent an average of 4.49 hours online per week. However, this trend changed during the pandemic as students from private colleges spent an average of 12.27 hours online and students from government colleges spent 11.69 hours online.

Effectiveness of Various On-line Resources/ Social Media Tools

On a query about the effectiveness of online teaching platforms, i.e. YouTube or Osmosis appeared to be the most effective, followed by online question banks. Students also quoted various other options. Student response was measured on a 1 to 5 scale, with 1 being the lowest and 5 indicating the highest percentage of use (Table 4).

METHOD	LEAST EFFEC TIVE n (%)	LESS EFFEC TIVE n (%)	NEUTR AL n (%)	MORE EFFEC TIVE n (%)	MOST EFFEC TIVE n (%)	MEAN	SD
Video tutorials - YouTube, Osmosis etc.	13 (4.2%)	7 (2.3%)	54 (17.6%)	104 (33.9%)	129 (42.0%)	4.07	1.03

Live tutorials via Zoom / similar platforms	51 (16.6%)	83 (27.0%)	117 (38.1%)	45 (14.7%)	11 (3.6%)	2.62	1.03
Online Question Banks	28 (9.1%)	46 (15.0%)	93 (30.3%)	90 (29.3%)	50 (16.3%)	3.29	1.17
Online Digital Flashcards	47 (15.3%)	62 (20.2%)	106 (34.5%)	64 (20.8%)	28 (9.1%)	2.88	1.17
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Online Question Banks	28 (9.1%)	46 (15.0%)	93 (30.3%)	90 (29.3%)	50 (16.3%)	3.29	1.17
Online Digital Flashcards	47 (15.3%)	62 (20.2%)	106 (34.5%)	64 (20.8%)	28 (9.1%)	2.88	1.17

(Table - 4)

Student perception of online teaching during the pandemic

Students did not find online teaching to be engaging or enjoyable. Students were of the view that opportunities to ask questions and clear doubts were limited during online sessions. Students ranked their experience of online teaching using a Likert scale with 1 being strongly disagreed and 5 being strongly agreed (Table 5).

STRONGLY DISAGREED (%)	STRONGLY DISAGREED (%)	DISAGREED (%)	NEUTRAL (%)	AGREED (%)	STRONGLY AGREED (%)	MEAN SD
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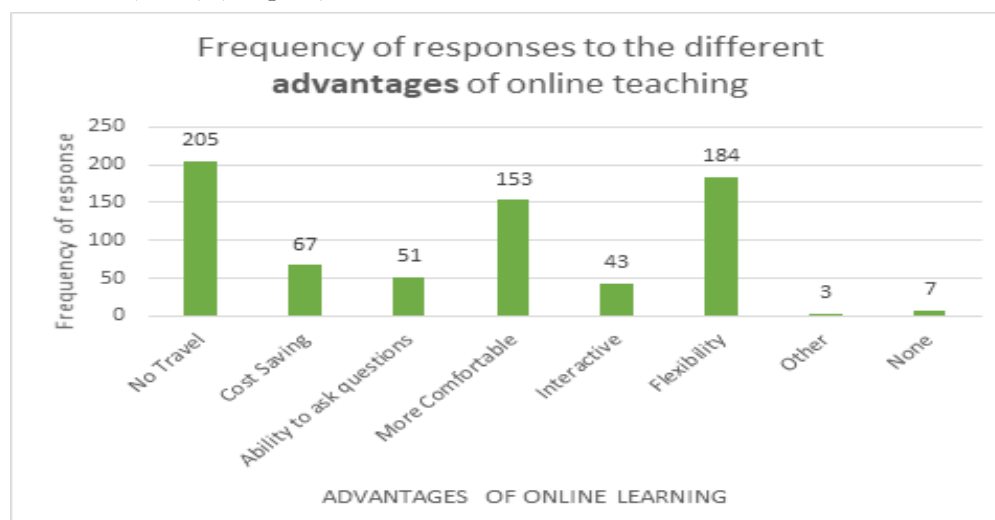
Teaching often stimulating	34 (11.1)	65 (21.2)	150 (48.9)	48 (15.6)	10 (3.3)	2.79	0.94
Easy to engage in session	68 (22.1)	84 (27.4)	97 (31.6)	44 (14.3)	14 (4.6)	2.52	1.12
Able to ask questions that I want	56 (18.2)	74 (24.1)	90 (29.3)	59 (19.2)	28 (9.1)	2.77	1.21
Enjoy online teaching	99 (32.2)	79 (25.7)	79 (25.7)	27 (8.8)	23 (7.5)	2.34	1.22
Like online teaching more interactive	33 (10.7)	26 (8.5)	72 (23.5)	103 (33.6)	73 (23.8)	3.51	1.24
Online effective as face-to-face teaching	144 (46.9)	82 (26.7)	46 (15.0)	17 (5.5)	18 (5.9)	1.97	1.17
Prefer online teaching to face-to-face teaching	159 (51.8)	63 (20.5)	38 (12.4)	29 (9.4)	18 (5.9)	1.97	1.24
Teachers are well prepared for teaching sessions	42 (13.7)	46 (15.0)	89 (29.0)	94 (30.6)	36 (11.7)	3.12	1.21
I am well Prepared for my profession	110 (35.8)	76 (24.8)	78 (25.4)	31 (10.1)	12 (3.9)	2.21	1.15

My internet connection can be problematic	30 (9.8)	40 (13.0)	63 (20.5)	77 (25.1)	97 (31.6)	3.56	1.31
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(Table 5)

Advantages of Online Teaching

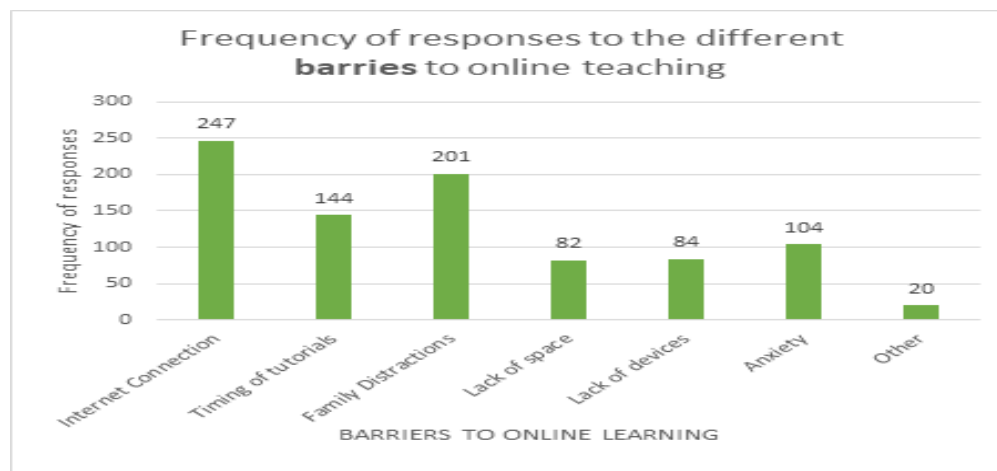
The main advantages of online teaching appear to be that it saves students time traveling (n=205), provides flexibility (n=184), is more comfortable (n=153), and cuts costs (n=67) (Graph 5).



(Graph 5)

Barriers faced during online Teaching

On the other hand, students stated that poor internet connection (n=247), family distractions (n=201), the timing of tutorials (n=144), and anxiety (n=104) served as barriers to effective online teaching.

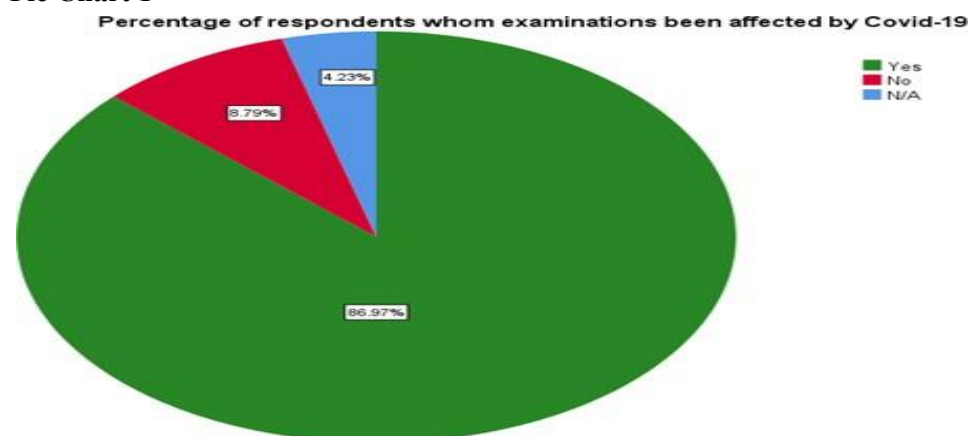


(Graph 6)

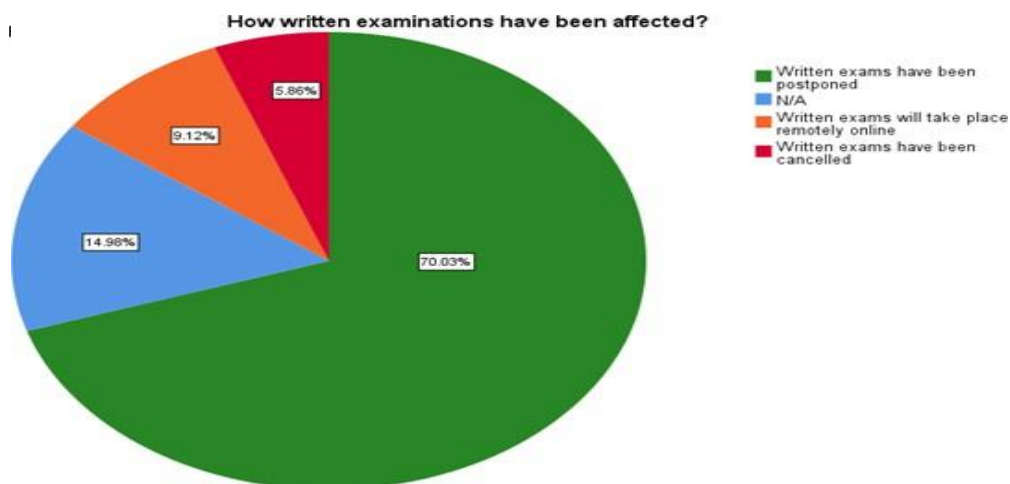
Impact of COVID on Examinations System

Most of the students, i.e. 86.97% of students responded by saying that examinations were badly hit while only 8.79% responded believed COVID did not impact the examination system, whereas 4.23% remained undecided (Pie Chart 1).

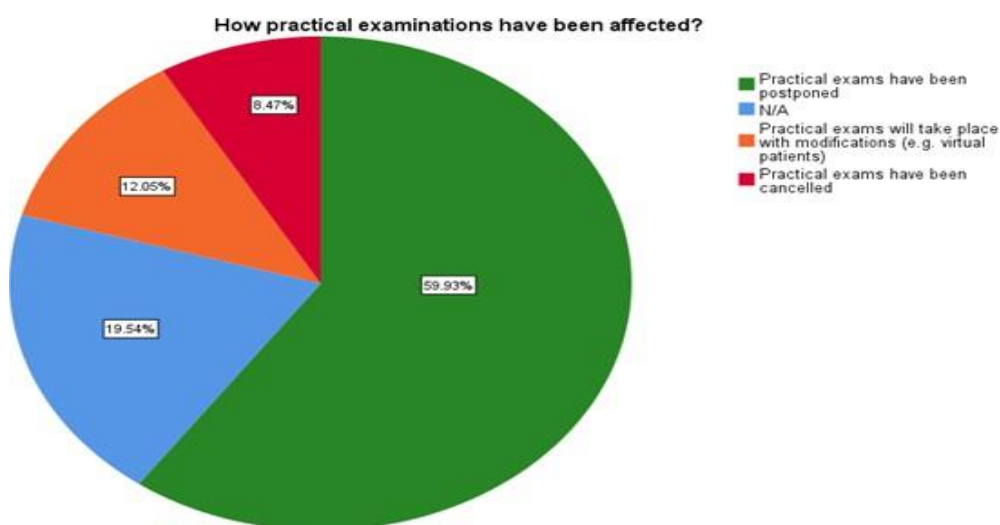
Pie Chart 1



On the other hand, the reality was that 70.03% of the written and 59.93% of practical examinations were postponed. Moreover, Practical exams conducted online were around 12.05%, here as only 9.12% of written exams were held (Pie Charts 2 -4).



Pie chart 3



Pie Chart 4

Findings of the Study

Medical students spent an average of 4.75 hours per week studying online before the pandemic. This contrasts with the 12.15 hours per week spent online during the pandemic (Graphs 1 & 2). Considering a previous study in the UK, this difference was significant with 7.35% of students spending more than 15 hours online before the pandemic, compared to 23.5% student population spending time during the pandemic

(Impact of COVID-19 Pandemic on Online Medical Education - An Online Survey of Students' Perspective - PubMed, 2024).

This difference is significant ($p < 0.001$), albeit expected since the primary method of instruction has shifted online, which when combined with the pre-existing online learning resources, has naturally led to an increase. One drawback to the data is that the responses of preclinical and clinical students were not recorded individually, hence, it was difficult to compare the engagement levels of the two student groups.

Data does show that students from the government sector spent more hours per week on average (5.78) compared to students from the private sector (4.49) before the pandemic (Graph 4). This can be attributed to a response bias since 79.8% of students who responded to our survey were from private medical colleges and only 20.2% from the government sector. The data therefore might have been skewed due to this large disparity in the sampling group. In contrast, research done in Kerala, India which considered 30 medical colleges found that 82.3% of the respondents were from Private medical colleges and only 17.7% from Government Medical colleges. In India, the reason for the smaller figures for Government Medical colleges was that some of the Government sector colleges failed to start or delayed online education during the pandemic (*Impact of COVID-19 Pandemic on Online Medical Education - An Online Survey of Students' Perspective - PubMed, 2024*).

For online learning, most students (77.5%) preferred online video tutorials, for example, YouTube and Osmosis to other methods such as live tutorials, online question banks, online digital flashcards, and others (Table 4). We can deduce that this is because online video tutorials are shorter, more organized, readily available, can be viewed comfortably at any time, have informative diagrams and photographs included, and can be rewatched again. Live tutorials, on the other hand, are time-restricted, not available for everyone, are less engaging, are hindered by connectivity issues, and cannot be reviewed unless they get re-uploaded by the instructors.

Regarding offline versus online teaching, most of the respondents complain about fewer opportunities available in online methods of teaching. They preferred to be part of discussions and favored offline options. Their experience of online learning was also assessed as less engaging & stimulating and suggested to be more interactive (Table 5) (average score of 3.51 out of 5, showing a majority in favor of desiring more interaction). This can be done by encouraging student participation through breakout rooms, pop quizzes, and Q&A sessions.

Social media platforms, including WhatsApp, have emerged as useful tools for delivering effective communication between instructors and students and can be

employed as well (**Ohara, 2023**). This method of active participation from both teacher & student ensures that questions and ambiguities regarding concepts are clearly understood to the entire satisfaction of both. Moreover, this option will certainly make the learning environment more active and enjoyable ((PDF) *The Significances of Participatory Learning Methods for the classroom Teaching*, 2022).

Students prefer offline, face-to-face teaching to online teaching, rating their experience of online teaching at an average score of 1.97 out of 5, implying that they do not enjoy online sessions. Indeed, 82.7% of respondents answered in the negative when asked if they feel online teaching has successfully replaced clinical teaching (Pie chart 1). On the contrary, according to a survey done in Sudan, approximately two-thirds (64%) of students agreed that online education is the best way forward (Siddiqui et al., 2024).

In our research, this can be due to the sudden shift from offline to online learning (as many students did not have the required online resources before the pandemic), technical difficulties, connectivity issues, and unfamiliarity with online teaching platforms. Since the switch was so rapid and had never been attempted before on such a large scale, it was also observed that the curriculum was underdeveloped, teachers lacked computer skills & online teaching techniques and institutions were ill-prepared which led to dissatisfaction of many. One can also deduce that such hurdles and irritants were the main cause of low scoring for online teaching (*The Sudden Transition to Online Learning: Teachers' Experiences of Teaching during the COVID-19 Pandemic* | PLOS ONE, 2023).

As the survey took over 3 months to collect data and arrive at conclusions, from an inter-institutional research team, findings suggest that the barriers that affect the development and implementation of online learning in medical education include time constraints, poor technical skills, lack of infrastructure, absence of strategies and negative attitudes of all involved.

Students also expressed dissatisfaction with their professional competence as 35.8% of respondents showed a lack of confidence in their preparation to become good doctors. (Table 3). Out of dissatisfied students, around 40% were from the 4th year, and about 9% from the 5th year, showed this to be a legitimate concern. They were of the view that clinical attachment has been discontinued, and their interaction & exposure with patients have been curtailed in hospitals and clinics. This has put them at a major disadvantage. Doctors who have been trained under the watchful eyes of their superiors in hospitals will have an edge over those staying at home with no clinical encounters. On the contrary, research done in France showed that medical students were in strong agreement about online teaching during the Covid-19 pandemic with an 89% response in favor. There was no significant difference between medical, allied, or nursing

students (*A Systematic Review of Health Sciences Students' Online Learning during the COVID-19 Pandemic* | *BMC Medical Education* | *Full Text*, 2022). But, at the same time, an example of France cannot be equated with the Pakistani experience, as Western societies are well-versed with computer technology, distance learning, and more so, their teachers & students have lifelong experience of using online instructions ((PDF) *Challenges and Barriers of E-Learning in Medical Education during the COVID-19 Pandemic from the Viewpoint of Teaching Staff*, 2024).

Additionally, 86.87% of responses stated that their examinations had been negatively affected, with 70% saying their written exams and 59.93% saying their practical exams were postponed (Table 5). This postponement of exams resulted in the extension of the total time of a particular medical course. Invariably, barring very few, medical colleges were not able to complete their curriculum within the scheduled time, thus, delaying in completion of the degree within the stipulated 5 years.

The research did find some benefits of online learning. According to students, online learning allows less traveling, thereby saving time, money, and effort. Moreover, the flexibility of classes and that too in more comfortable environment added advantage (Graph 5). For some students, asking questions anonymously and interacting online have also been a preferred option over face-to-face situations, making for a less intimidating learning experience. It is important to note that these responses are general, and results do not necessarily impact the overall disadvantages discussed earlier (*Students' Experience of Online Learning during the COVID-19 Pandemic: A Province-wide Survey Study* - *PMC*, 2021).

Most of the respondents cited internet connectivity, family distractions, the timing of tutorials, and anxiety as the major drawbacks to online studying (Graph 6).

Students belonging to large families, living in rural areas, or with internet issues are more inconvenienced, particularly more so if other family members also need internet access for their online learning.

Anxiety associated with online classes can be attributed to the loss of immediate feedback from teachers, feeling isolated from friends, internet connectivity, and timing of classes.

According to a study from India, out of 201 planned e-learning sessions, 82 were canceled due to technical reasons (20%) or no availability of the presenter at the host end (80%) (*Medical Students' Perception towards E-Learning during COVID-19 Pandemic in a High Burden Developing Country* | *BMC Medical Education* | *Full Text*, 2021).

This research pointed out that the most effective way of online teaching was video tutorials, with a significant 77.52% preference for Zoom/meet lectures in our study population. This is different from the research done in the UK, Japan, Malaysia, and France which has shown a greater impact of using mobile phones and joining live sessions for classes (Bączek, Zagańczyk- Bączek, Szpringer, Jaroszyński, & Kapłon, 2021).

This difference is because of the lack of good infrastructure and technologically abled staff here in Pakistan in pre-pandemic times. On a similar note, the study conducted in China discovered that most teachers were demotivated to teach online because of the lack of skills learned to do so (Camille Gardner & Henry, 2021).

Our study denotes that 86.97% of the examinations have been postponed ever since the pandemic struck. Comparatively, research in India and Chennai showed the move towards online formative assessment in undergraduate medical students where 58.8% of students agreed that online assessment has been significant in the learning of a particular subject (Wang et al., 2024).

This research points out that 51.8% of people strongly disagree that online teaching is the equivalent of face-to-face learning. Similarly, 35.8% of the participants strongly disagree that they are being prepared for their professional years ahead. This contradicts a study based in Morocco, where 79% of the students appreciated the role of online education in Medicine, however, other studies conducted in the UK, among the clerkship model of education showed similar results to our research where patient interaction was considered the epitome of medical knowledge and practice (Gardner & Henry, 2023). In the case of Morocco, students preferred to have online studies over totally discontinuing their studies, a lesser evil was opted as the preferred option.

Online available research resources for medical education are healthy and do meet the requirements of medical professionals. Moreover, as the use of online medical education grew, these tools were also updated, and knowledge uploaded on e-resources was current and up to date. Furthermore, the search for typical topics through an online system is much easier compared to using books for references, hence, time-consuming.

Before the pandemic, Govt sector students were utilizing online teaching facilities better than the private sector. This also denotes that Govt sector students were relying more on online resources, as they may not be getting adequate support from their institutional training.

A Man-Whitney U test found the difference in time spent on online platforms by government and private students before COVID-19 to be significant. ($p=0.028$).

However, during COVID-19, the difference in time spent on online platforms by government and private students is insignificant.

This also indicates that before the COVID period, Government sector students relied more on online resources rather than those available within their institutions. On the other hand, private sector students relied more on on-campus facilities than their counterparts. However, both groups understood the necessity of utilizing online medical education facilities, hence, they spent an approximately equal amount of time.

DISCUSSION

Online or virtual learning in medical education is a new concept that is rapidly expanding. Regardless of the reported benefits, medical students prefer the previous offline, face-to-face approach to online learning since the latter represented a major challenge to acquiring adequate clinical medical skills (especially for 4th and 5th-year students). It is therefore very important that the training and regulating bodies, medical schools, and professors are aware of all the problems and solutions regarding the development and implementation of this type of learning. Technical resources are reported as a major challenge for implementing online learning so understanding these issues is vital for the removal of all the barriers to online education.

Due to the unrelenting ascent of COVID-19 cases, medical institutions were forced to close their doors for on-campus education and training. They ultimately opted to employ online teaching for medical education. This research primarily focused on the perceptions of medical students regarding online education during the COVID-19 pandemic. It was generally believed that online education is not adequate and considered insufficient for the modern needs of medical training. Although online learning was used before this pandemic, it was never on such a large scale. It was therefore felt to discuss and analyze the attitudes and satisfaction levels of medical students toward online education.

During the research, the study group experienced certain limitations in assessing the situation in Pakistan's medical education during the COVID-19 era. Some of the major limitations that affected the outcome of the study are appended below:

Samples were collected in large numbers and analyzed carefully; this study was not without its limitations. One of these is the inability to calculate the response rate, which can lead to a non-response bias. Due to the inability to track the survey distribution, it was not possible to calculate a response rate. However, non-response bias was minimized by ensuring the survey was shared by a variety of medical students via a range of platforms. The study was carried out by an independent research group, hence, institutional / government support or access to government data was very

limited.

Another limitation was a time constraint, which resulted in 307 responses analyzed out of the original sample size of 500. Furthermore, 79% of samples were from private medical colleges, and out of those, 40% were 4th-year students, indicating that some medical colleges might have been represented in a disproportionate manner, which can cause the data to skew and result in a sample bias. In addition, the survey asked the students about their current place of residence (rural or urban) without following up on those questions. For example, the responses for internet connectivity, family distractions, and use of online resources before the pandemic were not recorded according to these two demographic groups as they were counted as general. Another limitation was that the study was restricted to only the students of Islamabad and Rawalpindi; therefore, it is difficult to arrive at a definite conclusion from covering only a small geographical area. For a truly in-depth, focused study on perceptions of medical students towards online education, the need was felt for more qualitative analysis and collaborative research with other medical schools.

Online or virtual learning in medical education is a new concept that is rapidly expanding. Regardless of the reported benefits, medical students prefer the previous offline, face-to-face approach to online learning since the latter represented a major challenge to acquiring adequate clinical medical skills (especially for 4th and 5th-year students). It is therefore very important that the training and regulating bodies, medical schools, and professors are aware of all the problems and solutions regarding the development and implementation of this type of learning. Technical resources are reported as a major challenge for implementing online learning so understanding these issues is vital for the removal of all the barriers to online education.

RECOMMENDATIONS

Given the discussions above, it is recommended that medical education needs a hybrid model to address such (COVID-19) eventualities, where, students and teachers can benefit from both, i.e. face to face teaching/ interaction as well as exploiting the goods of online resources. It is worth mentioning that in times to come, the world is moving fast towards Artificial Intelligence (AI). Medical education and treatment of the patients will also experience the tsunami effect of this change. Hence, medical institutions need to adopt these changes as early as possible. The use of the computer world and AI will also allow easy access to current and up-to-date medical knowledge available around the globe.

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