Opinion of Engineering Students on the Use of Live Online Lectures after the Pandemic

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Abstract—**The first outbreak of COVID-19 was reported in December 2019 and the disease took the shape of a pandemic in the next few months. Universities around the world imported lessons to their student mostly in online mode in 2020 and 2021. Thirty-five undergraduate computer science students were interviewed about their experience of attending online lectures during the COVID-19 pandemic. A quantitative analysis of their responses revealed that 43% of them felt that they can learn equally well from online and offline lectures, 49% felt that online lectures provide them flexibility which in turn helps them to perform better in academics and 54% felt that professors have improved their online teaching skills since the beginning of the pandemic. Further, a qualitative analysis revealed that students appreciate online lectures for allowing them to access ebooks and digital resources while attending lectures, and making it easier to study topics that require a lot of visualization and ask queries to professors. Consequently, 77% students said that a combination of online and offline lectures may be used in the future with students being allowed to choose how they learn. Alternatively, only online lectures may be scheduled on some days of the week so that students need not travel to the campus on those days.**

Keywords—**COVID-19 pandemic, online lecture, flexible learning, professor-student interaction, content delivery.**

JEET Category—**Research.**

I. INTRODUCTION

An outbreak of the coronavirus disease 2019 (COVID-19) was reported in China in December 2019. The disease spread throughout the world and took the shape of a pandemic. Universities around the world were forced to shut down their campuses and shift their academic activities online in the spring of 2020. Most universities have been using a combination of online lectures and other online resources to teach their students since then. Although the necessary technologies were available, online education was not typically considered seriously and rarely practiced in a large scale before the pandemic. COVID-19 and restrictions to check its spread compelled universities to rely heavily on online technologies.

Since the early days of the pandemic, professors have been designing novel strategies to teach their courses online and reporting their effectiveness in the literature. Interestingly, professors of medicine and related disciplines have been responsible for most of the innovations in online education in the last one and a half years (Chatterjee and Chakraborty, 2020).

In this paper, we use the term online lecture to denote a session in which a professor lectures and interacts with students in real time at an online platform. Similarly, we use the term offline lecture to denote a lecture delivered by a professor and attended by students in person in a physical classroom. It may be noted that several other terms have been used in the literature to denote what we call an online lecture and an offline lecture.

Online lectures have certain advantages over offline lectures. Online lectures provide quality interaction between professors and students in real time (Dhawan, 2020; Emanuel, 2020; Mahmood, 2021). Professors can provide impromptu feedback to students on their class work during such interactive sessions (Dhawan, 2020). Many students also find it easier to ask their queries to professors during online lectures (Emanuel, 2020). Most professors augment their online lectures with other online resources. These online tools typically support asynchronous interaction and can be accessed by students from anywhere anytime. Professors typically use ebooks, recorded lectures, visualization and simulation tools, and social media to enrich their courses. Professors can deliver online lectures from the comfort of their home, while students can attend them from anywhere. The flexibility provided by online lectures has been appreciated by both professors and students (Dost *et al*., 2020; Mahmood, 2021). Online lectures and the other online resources being used now have been mostly welcomed by today's generation of students and the same coincide with their learning preferences (Svoboda *et al*., 2021). Ortiz (2020) however cautioned that the shift from offline mode of education to online mode is not a transcriptional process but a translational

one which needs an entirely different set of tools and techniques.

The present study investigated the opinion of undergraduate computer science students in an Indian university on different aspects of online lectures. The students were interviewed and asked, *inter alia*, whether they would like online lectures to be used even after the pandemic is over.

II. USE OF ONLINE LECTURES DURING THE PANDEMIC

A. *Medicine and related disciplines*

Cho and Hong (2021) surveyed professors and students of plastic surgery programs in medical schools around the world where online lectures were being used during the pandemic. They found that 90% professors and 92% students had positive experience with online lectures. The professors were pleased because of less travel, convenience of delivering lectures from home, possibility of reaching out to a wider audience and better interaction with students. On the other hand, the students were pleased with online lectures because of the quality of the lectures which were being delivered by experts of international repute, convenience of attending lectures from home, ease of taking notes and screenshots, and interaction with professors. In another study, Khalil *et al.* (2021) interviewed undergraduate medical students at Qassim University, Saudi Arabia and found that online lectures were well accepted among the students.

Shrivastava *et al.* (2021) and Hattar *et al.* (2021) surveyed dental students in India and Jordan, respectively, and arrived at diametrically opposite results. Shrivastava *et al.* (2021) found that 86% students preferred offline lectures. Alternatively, Hattar *et al.* (2021) found 67% students preferred online lectures and 63% students felt that online education increased their collaboration with colleagues. The senior students were typically more comfortable with, and enthusiastic about, online education.

Choi *et al.* (2020) reported that recorded lectures and other asynchronous study material were used to provide a flexible learning environment to part-time nursing students at the University of Hong Kong. This pedagogical approach was however augmented with live online consultation meetings between professors and students.

B. *Science and engineering*

Lee (2021) and Lapitan *et al.* (2021) shared their experience of teaching chemistry through online lectures during the pandemic in South Korea and the Philippines, respectively. Lapitan *et al.* (2021) used a blended learning strategy for teaching courses on physical chemistry and analytical chemistry to students of chemical engineering at the University of Santo Tomas. They used online lectures along with asynchronous digital resources. They found that the grades received by students after attending the courses in online mode were better than those received by students in the previous year when the teaching was conducted in offline mode. Based on the experience at Pukyong National University, Lee (2021) remarked that online lectures are as effective as offline lectures for teaching courses in chemistry. Additionally, online lectures allow teaching and learning from more comfortable environment and better time management.

Lee (2021) reported that most students preferred keeping their camera off while attending online lectures. Many students avoid asking queries to professors during offline lectures so as not to disturb the sessions. Online lecture platforms allow students to send their queries as private messages to professors who can answer them as per their convenience. Several students benefitted from such interactions.

Busto *et al.* (2021) used a blended strategy for teaching mathematics at the University of Trento, Italy. They believed that teaching mathematics is a dynamic and creative activity where professors fine-tune their lectures in real time according to the reaction of students. They conducted a survey in which they asked students whether the body language and the facial expressions of professors made online lectures more interesting. They reported that 70% of the students who responded the question said that watching professors delivering the lectures mattered them a lot.

Chakraborty *et al.* (2021) surveyed undergraduate computer science students at Netaji Subhas University of Technology and found that the students were not very enthusiastic about online lectures. They reported that 66% students said that they learn better from offline lectures and 75% students said that interaction between professors and students occurs better in offline lectures. Further, only 32% students said that professors have improved their online teaching skills since the beginning of the pandemic and 36% students said that online lectures become more interactive if professors keep their camera on. The important aspects of online lectures that have been studied by different researchers are listed in Table I.

TABLE I
IMPORTANT ASPECTS OF ONLINE LECTURES

Aspect	Researchers who studied the aspect
Utility	Chakraborty *et al.* (2021), Cho and Hong (2021), Dhawan (2020), Dost *et al.* (2020), Khalil *et al.* (2021), Lapitan *et al.* (2021), Lee (2021), Mahmood (2021) and Shrivastava *et al.* (2021)
Applicability	Lapitan *et al.* (2021) and Sahi *et al.* (2020)
Flexibility	Cho and Hong (2021), Choi *et al.* (2020), Dhawan (2020), Dost *et al.* (2020), Khalil *et al.* (2021), Lee (2021) and Mahmood (2021)
Content delivery	Chakraborty *et al.* (2021) and Cho and Hong (2021)
Interaction	Busto *et al.* (2021), Chakraborty *et al.* (2021), Cho and Hong (2021), Dhawan (2020), Emanuel (2020), Hattar *et al.* (2021), Lee (2021), Mahmood (2021) and Svoboda *et al.* (2021)
Future use	Cho and Hong (2021), Khalil *et al.* (2021) and Svoboda *et al.* (2021)

III. RESEARCH MODEL

Most of the researchers who studied the efficacy of online lectures during the pandemic used self-designed questionnaires to do so. Khalil *et al.* (2021) however used focus group discussions in their study. We wanted to perform both quantitative and qualitative analyses of the opinion of the participants of the present study. We interviewed the participants individually. To support quantitative analysis, we framed six statements, *viz.* S1 through S6, covering different aspects of online lectures (Table II) and asked the participants how much they agreed with those statements. To support

TABLE II
THE STATEMENTS AND THE ASPECT OF ONLINE LECTURES THEY RELATE TO

Statement	Aspect
S1. One can learn equally well from online and offline lectures.	Utility
S2. All courses can be taught equally well through online lectures.	Applicability
S3. Online lectures provide flexibility to students and it helps them to perform better academically.	Flexibility
S4. Professors have improved their online teaching skills in the last one year.	Content delivery
S5. Online interaction can help in building strong professional bonds with professors and classmates.	Interaction
S6. A combination of online and offline lectures may be used after the pandemic.	Future use

TABLE III
THE QUESTIONS AND THE ASPECT OF ONLINE LECTURES THEY RELATE TO

Question	Aspect
Q1. What do you like about online lectures?	Utility
Q2. Which courses you think cannot be taught effectively through online lectures?	Applicability
Q3. Does it help if professors keep their camera on during online lectures?	Content delivery
Q4. Why students do not like to turn on their camera during online lectures?	Interaction
Q5. Do you interact with professors and classmates beyond the lecture hours?	Interaction
Q6. Should online lectures be used after the pandemic?	Future use

qualitative analysis, we asked six questions, *viz.* Q1 through Q6, to the participants again covering different aspects of online lectures (Table III).

IV. METHODOLOGY

A. Participants

We conducted the study on first year students of the undergraduate program in computer science and engineering with specialization in artificial intelligence at Netaji Subhas University of Technology. The students had taken admission in the program in the autumn of 2020, *i.e.* during the first wave of the COVID-19 pandemic. The students have been attending lectures and participating in other academic activities online since their admission except for about four weeks in between the first and the second waves of the pandemic, *i.e.* in February and March of 2021, when they were allowed to attend on-campus lectures and activities. Before taking admission in the university, all students had completed twelve years of formal schooling which was conducted in offline mode. We sent invitation to 62 students registered in the program on 7th June 2021 and 35 (56%) of them participated in the study.

B. Study protocol

The students were interviewed individually by the author through video conferencing between 8th and 10th June 2021. The students were first asked how much they agreed with statements S1 through S6. The students had to respond to each statement on a 5-point Likert scale where '1' represented 'Strongly disagree' and '5' represented 'Strongly agree'. Afterwards, the author asked questions Q1 through Q6 to the students and noted down their replies. The participating students were from the same program and of the same age,

and this helped in maintaining uniformity in the interviews with them.

C. Data analysis

We compared the distribution of the responses of the students for each of the six statements using chi-square goodness of fit test. The tests were conducted at 95% confidence level.

V. QUANTITATIVE RESULTS

The average age of the thirty-five students who participated in the study was 19.26 years (SD = 0.77). Thirty-three (94%) among them were male and two (6%) were female.

We found that 43% of the students felt, *i.e.* agreed or strongly agreed, that they can learn equally well from online and offline lectures (Table IV). However, only a small minority (9%) of them felt that all courses can be taught equally well through online lectures. Almost half (49%) of the students felt that online lectures provide them flexibility which in turn helps them to perform well in academics. Interestingly, a majority (54%) of the students felt that professors have improved their online teaching skills since online lectures were started in the university a year ago. Only 17% of the students felt that the online interaction that they are having right now can help them in building strong professional bonds with professors and classmates. Nevertheless, a large majority (77%) of the students felt that a combination of online and offline lectures should be used in the future. The distribution of the responses of the students were found to vary significantly ($P<0.05$) across the Likert scale for all the six statements (Table IV).

VI. QUALITATIVE RESULTS

A. Utility

On being asked what they liked about online lectures, students mentioned various points mainly related to learning experience and time management. Several students said that they liked the way they learn in online lectures. Some students said that they can access ebooks and other digital resources in real time while attending online lectures. Some other students said that online lectures are particularly helpful for courses that require a lot of visualization. One student said that he does not need be bothered about rest of the class and an online lecture almost feels like a one-to-one interaction with the professor. Some excerpts from the responses of the students are given below.

"It easy to access additional information while attending online lectures. I can switch between a PDF and the professor's camera for better understanding. ... Students who are shy can also take part in discussions during an online lecture."

"Live online lectures are better for only some courses. ... Online lectures are suitable for courses where we need to have a lot of visualization. So, the professor can show us some graphics regarding the topic he is teaching. ... The thing I like the most about online lectures is that we study mostly from

TABLE IV
SUMMARY OF THE QUANTITATIVE RESULTS

Statement	Responses					Mean±SE	Chi-square statistic	P-value
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree			
S1. One can learn equally well from online and offline lectures.	2 (5.7%)	6 (17.1%)	12 (34.3%)	13 (37.1%)	2 (5.7%)	3.20±0.17	16.000	0.003*
S2. All courses can be taught equally well through online lectures.	17 (48.6%)	10 (28.6%)	5 (14.3%)	2 (5.7%)	1 (2.9%)	1.86±0.18	24.857	0.000*
S3. Online lectures provide flexibility to students and it helps them to perform better academically.	1 (2.9%)	5 (14.3%)	12 (34.3%)	7 (20.0%)	10 (28.6%)	3.57±0.19	10.571	0.032*
S4. Professors have improved their online teaching skills in the last one year.	2 (5.7%)	1 (2.9%)	13 (37.1%)	13 (37.1%)	6 (17.1%)	3.57±0.17	19.143	0.001*
S5. Online interaction can help in building strong professional bonds with professors and classmates.	12 (34.3%)	11 (31.4%)	6 (17.1%)	3 (8.6%)	3 (8.6%)	2.26±0.21	10.571	0.032*
S6. A combination of online and offline lectures may be used after the pandemic.	1 (2.9%)	5 (14.3%)	2 (5.7%)	10 (28.6%)	17 (48.6%)	4.06±0.20	24.857	0.000*

*P<0.05.

ebooks and other digital resources which are very convenient to use."

"Online lectures help us in developing a better understanding of topics being discussed. ... Online lectures almost become a one-on-one interaction with the professor."

Two students said that it is easier to ask queries to the professor during an online lecture. The students said that they can type in their queries in the chatbox without interrupting the lecture and the professor can answer them when s/he finds it suitable.

"Asking queries is easier and more comfortable during online lectures."

"We can ask queries by typing in chatbox during an online lecture. The professor can answer them as per his convenience."

New Delhi is a large city and students often spend a lot of time commuting between their homes and the university. Twelve (34%) students said that they prefer attending online lectures because doing so cuts their travel time which they can use in more productive ways.

"I don't have to get up at 6 in the morning and travel 20 Km for attending lectures! ... I feel pretty comfortable in my house. I can eat and drink whenever I want, but that's not the case with offline lectures."

"It takes me an hour to reach the university from my home. So, online lectures save a lot of time for me on a daily basis."

"Online lectures cut the time we spend in commuting and anyone can join online lectures no matter where he is."

"Online education saves the time that we typically spend in travelling and it is much easier to attend classes from anywhere and anytime."

"I like the flexibility and easier time management afforded by online lectures. ... I don't have to spend too much time travelling."

"We save the travelling time which we use in more productive ways."

"There is no wastage of time in travelling in case of online lectures."

"Online classes help us to utilize the time we waste in traveling."

Additionally, some students said that online lectures help them in better time management. The students appreciated the flexibility provided by online lectures and said that it helps them in scheduling their academic and leisure activities.

"Time management becomes easy with online classes."

"Online education gives me a lot of time to pursue my non-academic interests."

"Online classes allow me to use my time flexibly."

"Attending lectures online gives me more free time."

"I can attend all the lectures in the comfort of my home and I don't have to wait in the university campus if one lecture is scheduled after 2 or 3 hours."

Several students said that online lectures provide them more flexibility and they can attend online lectures from anywhere they like. The students liked the fact that with online lectures they need not miss their studies even though they cannot come to the university.

"There is more flexibility with online lectures."

"You can attend lectures from anywhere. So, it increases your attendance and you don't have to miss lectures even if you have to go out of the station."

"The flexibility that online lectures provide is something I like the most. I can attend a lecture and instantly shift to some other task as soon as the lecture ends. ... I get comparatively much more time to revise the lessons as compared to on-campus lectures. Late night study doesn't remain a problem anymore since we do not get tired physically due to travelling to the university and back to home."

Furthermore, one student said that online lectures help him in balancing between academics and life.

"Online lectures help me in balancing between my studies and my life."

However, there were some students who did not like attending lectures online. Four students said that they liked 'nothing' about online lectures. One student complained that attending online lectures causes him mental fatigue.

"Online lectures only cause mental fatigue. ... I want offline classes to resume as soon as possible."

B. Applicability

When asked, the students named a few subjects courses in which they felt cannot be taught effectively through online lectures. Nineteen (54%) students said that they find it difficult to study courses in mathematics when taught through online lectures. Eight (23%) and five (14%) students said that

they find it difficult to follow online lectures of courses in physics and electronics, respectively. Some students said it is the style of teaching of professors rather than the content of the courses that decides how easy it is to follow the online lectures. Four (11%) students felt that all courses can be taught effectively through online lectures. Some excerpts from the responses of the students are given below.

"Mathematics is the only course that I think cannot be taught properly in online lectures. Mathematics at engineering programs is quite challenging since it goes beyond equations. Some concepts need to be discussed thoroughly and it requires interaction and cross questioning to make those concepts understandable. ... I feel the level of interaction remains low in online lectures. Though concepts can be taught efficiently in online mode, but some offline sessions are necessary for the students to explain to the professor the difficulties they are facing while solving problems."

"Courses concerning electronics and courses like mathematics and physics can be taught only if the professors use whiteboards and other tools properly."

"It is difficult to teach and learn non-computer science courses through online lectures."

"It is not about the courses, but it is about the professors who are teaching the courses. The same course can be taught by two professors and I can understand every concept from one professor but nothing from the other."

C. Content delivery

Students said that if professors keep their camera on, then the lectures become more interactive and it also helps them to stay focused. Thirty-four (97%) students said that it helps them if professors keep their camera on during online lectures, while one student felt that the same is of 'not much' help.

The interaction between the professor and the students is mediated by computer in online lectures. Most students felt that online lectures become more interactive if professors keep their camera on. Some excerpts from the responses of the students are given below.

"Yes. It improves the interaction with the professor."

"It helps in making the lectures more interactive. I can understand better in that way."

"Yes, it makes the lecture interactive."

Additionally, some students said that they find it easier to concentrate on the lectures if professors keep their camera on.

"Yes, definitely it helps as it increases my focus. I don't get distracted when the camera of the teacher is on."

"Yeah, it definitely does help me. ... It helps students in maintaining concentration and keeps them engaged."

"Yes, it helps us to stay focused. ... We observe how the professors are saying the things and we can understand better by watching their expressions."

"Yes! Online lectures come with a lot of distractions. ... When professors keep their camera on and interact, then I feel a lot more attached to the lectures and I attend the lectures with an increased focus."

One student however pointed out that it is necessary for professors to show the whiteboard throughout the lectures while teaching certain courses.

"Sometimes it makes the lectures more interactive, but the whiteboard is almost always required for some courses."

D. Interaction

On being asked, the students explained why they do not prefer to turn on their camera during online lectures. Some students said that they do not turn on their camera because they are conscious about their look. Some excerpts from the responses of the students are as follows.

"Students keep their camera off because they are conscious about the way they look."

"I think children are conscious about their look. ... They fear that others will make fun of them if they do not look formal."

"Yes, we are conscious about our look as most of the time we are casually dressed at home."

"Some lectures start at 8'o clock in the morning. We have just woken up and are sleepy."

However, more students said that the environment at their home is not much formal and that is why they prefer keeping their camera off.

"Students attend online lectures from their homes where the environment is informal. So, they prefer not to switch on their camera."

"We are conscious about look and surrounding. ... We are at home and there is no separate room to attend online lectures. It makes us conscious about surrounding."

"I guess students are conscious about their surroundings. ... Everyone isn't privileged enough to have a separate, peaceful and well furnished room where they can attend online lectures."

More specifically, a few students said that they are apprehensive about a family member being inadvertently visible doing household chores in the background.

"Students are insecure about sudden appearance of a family member or how they or their background looks. Hence, they keep their camera off."

"It is not about the look but about the surroundings. Many times there are other family members entering the room or might be working in the background and that makes students feel awkward in front of their classmates."

Nevertheless, some students felt that keeping their camera off allow them to be more relaxed while attending online lectures.

"Keeping the camera off allows us to be more relaxed."

"Students feel free if their camera is off and can learn without feeling being monitored."

"Most people are conscious about their look and surrounding, and feel more comfortable keeping their camera off."

The students also talked about their interaction with professors and classmates beyond the lecture hours. Twenty-six (74%) of the students said that they had some interaction with professors and classmates beyond the regular online lectures. Some of those students were satisfied with the level of interaction and they described how they interacted with the professors and their peers as follows.

"Yes. We [students] interact through WhatsApp and Google Meet."

"We students interact a lot through various social media platforms."

"Yes, I interact with my classmates mostly through WhatsApp."

"I interact with classmates and professors via WhatsApp groups and LinkedIn."

"Yes, I interact with professors and classmates. I interact with professors mainly through text messages and with classmates through text messages and phone calls."

"Of course! We [students] discuss about the topics we are studying and sometimes some questions after the lectures."

Some students said that they interacted with professors and classmates beyond the regular lectures, but their interactions were limited to curricular activities.

"Sometimes I interact with my classmates for important stuff like syllabus and assignments. However, there is no frank interaction."

"I do not interact with the professors [beyond the lectures]. However, I interact regularly with my friends regarding the lectures and related things."

"I interact with professors only when there is an issue. I interact with some of my classmates with whom I have friendly relation. I do not socialize much with students whom I do not know well."

"I interact with my classmates beyond the lectures, but not with the professors."

Few students said that they hardly interact with any professor or student apart from what they do during the online lectures.

"No, there is barely any interaction after the lectures."

"I don't interact with anyone. This isn't possible in online lectures. I just want offline lectures to resume."

E. Future use

When asked whether online lectures should be used after the pandemic, four (11%) students said that online lectures should be used predominantly after the pandemic while another eleven (31%) students said that online lectures should not be used at all. The remaining twenty (57%) students said that it will better to use a combination of online and offline lectures. Some students were found to prefer online lectures over offline lectures. Some excerpts from the responses of the students are given below.

"Yes, live online lectures should be used."

"I think yes, because online lectures save lots of time which we spend on travelling. ... Now, we can spend the rest of our time in co-curricular activities and can focus on study as well."

"Online lectures can be used to teach courses related to computer programming. ... I find studying computer programming in online lectures to be easier than in a physical classroom."

"Yes, as it is now in online lectures, we can do much more things using visual graphics than on the board."

"Some students of my class find it difficult to follow lectures in English. They read the subtitles as the professors speak in online lectures. This is a big help for them. ... Differently-abled students find it easier to attend lectures online."

Several students wanted a combination of online and offline lectures to be used in the future so that they can get the benefits of both.

"Online lectures may be used for some of the courses."

"We can have online lectures for some courses but they should be integrated with offline lectures."

"Yes. However, many students like me also like offline lectures. So, I would prefer a mix of online and offline lectures depending on the course and the topic being taught."

"Yes. A combination of online and offline lectures should be used. Laboratory classes should be held offline. However, computer science courses should be taught online, with occasional doubt solving sessions held offline. ... I personally feel doubt solving can be done offline much better in courses in mathematics and physics."

"Yes. It should be in dual mode actually."

"Yes, a combination of online and offline lectures should be used."

"A combination of both modes would be a great idea."

"I feel there should be a mix of online as well as offline mode of teaching."

"A combination of live online lectures and lectures in traditional classrooms may be used after the pandemic."

"Lectures on Thursdays and Fridays as well as extra classes, if required, should be held online as it will give us ample time for self study."

Additionally, some students suggested that they should be allowed to choose between online and offline lectures.

"There are a lot of students who are fine with how the lectures are going on right now and there are some who are not. So, I think there should be a choice to attend lectures online or offline."

"There should be a choice whether we want to attend online lectures or offline lectures. So, we can choose the courses we want to study online and the others we can study offline."

"Options should be given to the students. Those who want to attend lectures offline can attend them offline and those who want to attend lectures online can attend them online. ... Offline classes are way better because we get to meet and hangout with our friends. We get to enjoy our college life."

There were also a few students who clearly preferred attending offline classes.

"I feel offline lectures should be favored."

The key points in the responses of the students have been listed in Table V.

VII. DISCUSSION

Our survey of the literature revealed that the opinion of students on online lectures vary widely. Final year undergraduate students and postgraduate students are typically more supportive of online lectures. However, the opinion of students is influenced by the way teaching-learning processes are implemented by their university. In most universities, students were initially uncomfortable with attending online lectures but gradually became habituated to it. We compared the results of the present study with those of earlier studies.

A. How is the learning experience with online lectures?

We found that only 43% of the students in the present study felt that they could learn from online and offline lectures alike. This is in contrast with the results of Cho and Hong (2021) who found that 92% students had positive experience with online lectures and Hattar *et al.* (2021) who found 67% students preferred online lectures over offline lectures. The students in the present study however appreciated the fact that

TABLE V
SUMMARY OF THE QUALITATIVE RESULTS

Question	Key points in the responses of the students
Q1. What do you like about online lectures?	• Real time access to digital resources • Convenience of asking queries to professors • Avoiding daily commuting • Flexible time management • Attending lectures from anywhere • Help in balancing between academics and life • Students who find it difficult to follow lectures in English can read the subtitles in real time • More convenient for differently-abled students
Q2. Which courses you think cannot be taught effectively through online lectures?	• Courses in mathematics, physics and electronics are difficult follow in online lectures • The style of teaching of professors is also an important factor
Q3. Does it help if professors keep their camera on during online lectures?	• Makes online lectures more interactive • Makes it easier to concentrate
Q4. Why students do not like to turn on their camera during online lectures?	• Conscious about look • Informal environment at home • Feel more relaxed
Q5. Do you interact with professors and classmates beyond the lecture hours?	• Students use social media sites and instant messaging apps to interact beyond the lectures • Students interact among themselves and sometimes with professors
Q6. Should online lectures be used after the pandemic?	• A combination of online and offline lectures should be used • Students may be allowed to choose between online and offline lectures

they could access quality online resources in real time while attending online lectures. Two students in the present study said that they find it easier to ask queries to professors during online lectures. Such an observation was also made by Lee (2021). We found that 34% students in the present study felt that online lectures allowed them to use the time they spend on travelling between home and university on more productive activities. Some students in the present study appreciated online lectures for allowing them to study in the comfort of their home. Similar observations were earlier made by Cho and Hong (2021) and Lee (2021).

B. What is the most cherished aspect of online lectures?

Researchers like Dost *et al*. (2020) and Mahmood (2021) have praised online lectures for providing a flexible learning environment to students. We found that about half of the students in the present study believed that online lectures provide them enough flexibility that allows them to learn in a better way. They said that they could attend lectures from anywhere and need not miss lectures even if they are out of town. In a study conducted just before the beginning of the pandemic, Kauppi *et al*. (2020) found students attending online educational programs complain about missing the human contact but appreciating the flexibility.

C. Can all courses be taught through online lectures?

Most of the students in the present study felt that not all courses can be taught equally well through online lectures. They said that courses in mathematics and courses that require physical laboratories are difficult to follow through online lectures. However, it may be noted that some professors have been able to teach courses in mathematics (Busto *et al*., 2021) and chemistry (Lapitan *et al*., 2021; Lee, 2021) successfully through online lectures.

D. Have professors improved their online teaching skills?

A preliminary study was conducted in the same university, but with different students, in September 2020 (Chakraborty *et al*., 2021). In that study, only 32% of the participating students said that professors have improved their online teaching skills since the beginning of the pandemic. In the present study, 54% of the students said the same about the professors. We interpret these results as professors, who had little experience of teaching online before the pandemic, gradually improving their online teaching skills. Additionally, several students in the present study reported to have interacted with professors through digital media more than ever before. Such an observation was also made by Oliveira *et al*. (2021).

E. Should professors keep their camera on?

All but one student in the present study said that they found it helpful if professors kept their camera on during online lectures. They said that being able to watch professors delivering lectures help them to concentrate and also make the session more interactive. Previous studies have reported 36% (Chakraborty *et al*., 2021) to 70% (Busto *et al*., 2021) students saying that they preferred watching professors delivering lectures.

F. Why students keep their camera off?

Lee (2021) reported that most students prefer to keep their camera off while attending online lectures. The students in the present study said that they keep their camera off during online lectures because they are conscious about their look and their surrounding which is often informal at home. However, few students said that keeping the camera off make them feel more relaxed during online lectures.

G. How online lectures should be used in the future?

In the present study, 77% students felt that a combination of online and offline lectures should be used in the future. Three interesting alternatives were suggested by the students. First, some students said that the content of a course should determine if it should be taught through online or offline lectures. Sahi *et al*. (2020) and Khalil *et al*. (2021) had earlier remarked that certain courses in medical schools that can

easily be taught online. Second, some students said that they should be allowed to choose whether they attend lectures online or offline. Third, some students said that only online lectures should be scheduled on certain days of a week so that students need not travel to the university campus on those days. Cho and Hong (2021) had earlier reported that 75% students felt that online lectures may replace offline lectures in the future.

VIII. CONCLUSION

Although the necessary tools and techniques were available, online lectures were neither taken seriously nor used in large scale before the pandemic. However, online lectures have helped in maintaining the continuity of educational processes in the last one and a half years. Most universities around the world are now using online lectures as the primary mode of instruction with other digital resources playing secondary roles. The experience of students with online lectures varies widely. Such variation in opinion arises due to the way in which online education is being implemented in different universities and other local factors. Students from around the world have typically appreciated the flexibility, convenience and interaction provided by online lectures.

Most students in the present study said that they would prefer learning through a combination of online and offline lectures. Professors and students in most universities have been using offline lectures as the primary teaching-learning technique so far. They will gradually become accustomed to online education. As Ortiz (2020) had observed, the shift from offline education to online education is not a trivial change. Professors will require improving their skills for teaching though online lectures and students will require adjusting to the new medium of instruction.

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