

Online Education and Its Repercussions on Engineering Students During Covid-19: A Survey

Anand Jha¹, Kirti Raj Bhatele², Chaitanya Sharma³, Ajay Tripathi⁴

¹ Department of Information Technology, RJIT, Tekanpur, India-475005

² Department of Computer Science and Engineering, RJIT, Tekanpur, India-475005

³ Department of Mechanical Engineering, BIT, Sindri, Dhanbad, India-828123

⁴ Department of Mechanical Engineering, GEC, Raipur India-492001

Abstract : The spread of Coronavirus pandemic and the resulting lockdown has significantly disrupted every facet of human life including education. The education system has never thought of such an unprecedented situation and thus, it had caused a colossal disparity within it. More than 1.2 billion children were out of the classroom, in India almost 32 crore learners stopped going to educational institutions. In India the online learning has many concerns like awareness, its effectiveness, stable internet connectivity, electricity supply, required devices etc. In this study we are trying to address such queries, constraints and to analyse impacts of COVID-19 on the students by understanding their opinion, inclinations and their mental health via an online survey of 399 engineering students in two institutions of Raipur, Chhattisgarh, India. Our results revealed that smartphone is the most popular device since 88.97% used it whereas mobile GPRS is the first choice for the Internet connectivity since 75.18% respondents used it.

Keywords: COVID-19; online education; perception; repercussion, engineering.

Anand Jha

Department of Information Technology, RJIT, Tekanpur, India
mail2anandjha@yahoo.co.in

1. Introduction

A. COVID-19: The Pandemic

The COVID-19 disease caused by novel coronavirus initially appeared in Wuhan city of China at the end of 2019. Since then, new coronavirus outwardly began to spread and became a pandemic on 11th Mar 2020 (DG-WHO, 2020). In India, the first COVID-19 positive case was reported in Kerala on 30th Jan 2020 (Jena, 2020). Since then, India has witnessed sparkled growth in COVID-19 cases through two waves of COVID-19. Subsequently, the government of India together with state governments has taken several steps to curb the spread of the COVID-19 disease including extension of the lockdown in many phases and stringent precautionary measures like social distancing, follow-up of instructed quarantine procedure, wearing masks and following other hygiene and sanitation etiquettes (Khachfe et al., 2020).

B. Education sector of India: The Colossal One

The Table 1 shows the academic population in India (UNESCO, 2021). India has 2nd largest number of students in the world and India's higher education system is 3rd largest in the World after the United State of America and China.

The Indian Education sector is significant since it

has 1.4 million schools and 993 Universities, 39931 Colleges, 10725 Autonomous institutions that conducts higher education through Under-graduate (UG), Post-graduate (PG), Doctoral (Ph.D.) and Post-doctoral courses under various streams according to the AISHE web portal (AISHE, 2019). Total number of enrolments in all higher educational institutes' is 37.4 million which constitutes 19.2 million males and 18.2 million females resulting in 26.3% Gross Enrolment Ratio (GER) in the higher education of India, which is calculated between age group of 18-23 years (AISHE, 2019).

Table 1:
Population At Different Academic And Age Levels

Education level	Population of students	Official school ages by level of education
Pre-primary	69,409,922	3-5
Primary	121,821,478	6-10
Secondary	177,585,036	11-17
Tertiary	123,012,080	18-22

C. Impact of covid-19 on education

The most preferred way to reduce the spread of COVID-19 pandemic is to enact COVID-19 containment actions in the respective lands (Brouwer, E. De, Raimondi, D., Moreau, Y., 2020), restricting all non-essential public movements (Saha, J., Barman, B., & Chouhan, P., 2020), taking stringent precautionary measures like social distancing, follow-up of instructed quarantine procedure, wearing masks, following other hygiene and sanitation etiquettes (Brouwer, E. De, Raimondi, D., Moreau, Y., 2020). So, India announced a nationwide lock-down of all educational institutes on 16th Mar 2020 (Khattar, A., Jain, P. R., & Quadri, S. M. K. (2020). Central Board of Secondary Education (CBSE) deferred all examinations of secondary and higher secondary schools on 18th Mar 2020. Such decisions affected more than 32 crores of students across India (Sharma K., 2020). At the end of April 2020, 186 countries have executed nationwide shutdown, thus disturbing about 73.8% enrolled learners as per UNESCO (UNESCO. 2020). As educational institutions were shut for an indefinite time, a swift change in learning pedagogy was demanded from both the institutions and students. This results in adoption of online teaching-learning (Kapasias, N., Paul, P., Roy, A., et al., 2020; Adnan, M., & Anwar, K. (2020). Online learning helped to continue learning during tough pandemic time, it would be worth to understand experiences and perceptions of learners to make online learning better because experience of online teaching-learning can be

different across different subject areas (Gu, Z., 2002). Another reason to know students' perception is quality consideration in online learning atmosphere since it varies greatly from the traditional classroom setting especially when we are talking about learner's motivation, satisfaction and interaction (Bignoux, S., & Sund, K. J., 2018).

In this study we analysed the impact of COVID-19 on the life of engineering students and also understood their preferences and perception. The study has relevance for reasons: (1) In India, online teaching-learning has never been tried before at such a massive scale, (2) earlier, online learning was considered supportive only, it has never been thought of as a way of imparting education, (3) COVID-19 brought a substantial social change by forcing an abrupt transition to online learning and (4) engineering education offers paramount importance to practical learning. Due to these reasons, it would be beneficial to get an insight into student's mind about online education, especially about practical learning, so that course content can be better structured for online mode of education.

2. Literature Review

(Warner et. al ,1998) anticipated the notion of learners' willingness for online learning mode of vocational education and training segment of Australia. The study proposes that willingness has three characteristics: (1) Learners' preference for the mode of dispensing learning instructions, (2) learners' competence in using electronic means of communication, Internet and (3) learners' ability to participate in self-directed learning. (McVay, 2000; McVay 2001) proposed a 13-element mechanism to quantify learners' behaviour and attitude. (Smith et al., 2003) came-up with 2-components: Comfort with e-learning and Self-management of learning. Aspects influencing the willingness for online learning were: (1) self-directed learning (Guglielmino, 1977; Garrison, 1997; Lin and Hsieh, 2001; McVay 2000; McVay 2001); (2) motivation for learning (Deci and Ryan, 1985; Ryan and Deci, 2000; Fairchild et al., 2005) (3) learners' control (Hannafin, 1984; Shyu and Brown, 1992; Reeves, 1993), (4) computer and Internet self-effectiveness (Bandura, 1977,1986; Bandura et al., 1999; Compeau and Higgins, 1995; Eastin and LaRose, 2000; Tsai and Tsai, 2003; Tsai and Lin, 2004; Hung et al., 2010), (5) self-efficacy in electronic communication (Palloff and Pratt, 1999; McVay, 2000; Roper, 2007).

Numerous studies have reported encouraging and hindering learners' viewpoints of online learning. Many studies expressed that the teacher's synergy with the learners remarkably influences the learners' viewpoints of online learning. Table 2 outlines a handful of studies conducted to determine professed strengths of online learning.

Table 2 : Strengths Of Online Learning

Authors	Strength(s) of online learning
Swan et al., 2000	steadiness in course scheme
Duffy et al., 1998	Teachers' communication ability to stimulate critical reasoning competence
Chizmar and Walbert, 1999; McCall, 2002	The degree of instructional significance and adjustability.
Soo and Bonk, 1998; Wise et al., 2004; Kim et al. 2005,	likelihoods of involvement with tutor and mates.
Barab and Duffy, 2000; Kim et al. (2005); Jonassen, 2002	community presence.
Trautwein et al. , 2006; Lim et al., 2007	studious self-concept
Wagner et al., 2002	obligatory technological competencies

Researchers also attempted to address flaws of online learning. Table 3 summarizes some barriers in online learning from literature.

Table 3 : Weaknesses Of Online Learning

Authors	Addressed Weakness (es) of online learning
Hara and Kling ,1999; Petrides, 2002; Vonderwell, 2003	deferred responses
Petrides 2002;	disbelief of peer's expected expertise
Woods, 2002; Vonderwell, 2003	absence of social sentiments, segregation sense
Piccoli et al., 2001; Song et al. 2004,	collaborative difficulties with the co-learners, technical glitches
Muilenburg and Berge, 2005	concerns pertaining to instructor
Frankola, 2001; Ryan, 2001; Laine 2003,	greater learner erosion rate
Golladay et al. 2000); Serwatka (2003)	requirement of added discipline, writing proficiencies, and self-motivation and requirement of time devotion

So, assessment of online learning versus traditional classroom experiences has been addressed by studies and blended conclusions were reported. No notable difference between online and traditional learning were observed on the basis of learners' gratification and educational achievement (Hara and Kling, 1999). (Nguyen, 2015) backed that online learning will be equally effective as offline learning if designed suitably. Since few distance education platforms tried online learning before COVID-19 pandemic,

sufficient studies have not been tried to know the learners' perception and preferences in Indian context of online learning. We tried to fulfil this gap in engineering education domain with our study.

3. Objective And Methods

A. Participants

The study is based on data collected online through Google Forms. Google Form link was sent to participants through WhatsApp. Survey data collected from 399 diploma and undergraduate engineering students. Engineering students were selected as participants because engineering education has substantial part of practical learning besides theoretical learning.

B. Study Design

Online survey was piloted from 8th Aug 2021 to 12th Aug 2021. 53 questions were asked that includes multiple-choice questions, yes/no questions, and some questions allowed participants to enter text. The questions can be categorised in following groups:

A. Demographic information

B. Academic life during COVID-19 and COVID-19 impact on education

C. Required facilities and skills for online classes during COVID-19

D. Social, emotional and personal life

E. Students' perception and preferences about online classes during COVID-19

A participant must be logged-in using his/her Gmail account for participating in this survey, it restricted duplicate/multiple entries from same participant.

C. Ethical Concern

No participant forced to participate in the online survey and no classifying information gathered from participants.

4. Results And Discussion

A. Demographic Characteristics of Participants:

Table 4 shows the demographic information like gender, age, level of study, place of residence. of the participants. Male respondents, 65.92% (263) were more than female respondents 34.08% (136). Only 5.51% (22) respondents belong to 3-years diploma course and 94.48% (377) belong to engineering degree course. Out of 377 engineering degree course respondents, 368 were pursuing 4-years engineering undergraduate degree course and 09 were from 2-years engineering post graduate course. The highest number of respondents 71.42% (285) belong to age group 18-21 years with the mean age of respondents is 21 years. Our respondents' dataset is balanced since 171 (42.86%) respondents are from urban region, the respondents from rural region are marginally less at 151 (37.84%) and 77 (19.23%) respondents belong to semi-urban region.

Table 4 :Demographic Characteristics of Participants

Demographic Attribute		Total number of participants, N = 399	
		No. of respondents	Percentage
Gender	Male	263	65.92 %
	Female	136	34.08 %
Institute Name	GEC, Raipur, Chhattisgarh, India	377	94.48%
	Govt. Polytechnic Bhatapara, Chhattisgarh, India	22	5.51 %
Age	18-21	285	71.42%
	21-24	109	27.32 %
	24-27	5	1.25 %
Level of Study	UG	368	92.23 %
	Diploma	22	5.51 %
	PG	9	2.26 %
Locality of Residence	Urban	171	42.86 %
	Rural	151	37.84 %
	Semi-urban	77	19.23 %

B. Academic Life during COVID-19

Academic life during COVID-19 was addressed via two questions: mode of education during COVID-19 and platform used for online teaching-learning as depicted in table 5. Live online class was the most preferred way of continuing education in pandemic since 68.92% (275) respondents were attending live online classes. This was expected since during live online classes (1) students can interact with teachers about their doubts and teachers can respond immediately unlike recorded videos; (2) live online

classes platform also includes supportive learning facilities like graphic tools, document sharing, live chat etc. Recorded videos (12.78%) was second preferred choice. Only 8.27% were using presentation and other study materials as mode of education during Covid19 pandemic. Combination of Google Classroom and Google Meet was the first choice with 67.92% (271) as a platform. This choice of platform is natural because approximately same percentage of candidates chosen live online classes as the mode of education.

Table 5 :Academic Life During Covid-19

Question	Response	N = 399	Percentage
Mode of Education During COVID-19	Live Online Classes	275	68.92 %
	Recorded Videos	51	12.78 %
	Video Conferencing	40	10.02 %
	Presentation and study materials to Students	33	8.27 %
Platform used for online teaching-learning	Google Classroom and Google Meet	271	67.92 %
	Zoom and Google Classroom	78	19.55 %
	Google Meet and What's app	37	9.27 %
	Zoom and What's app	8	2.0 %
	What's app only	1	0.25 %
	Other	4	1.0 %

C. COVID-19 Impact on Education

Impact on education was assessed by 4 questions: (1) Teaching support during COVID-19 pandemic, (2) Adaptability to online learning, (3) Performance in online-learning, (4) Study workload increased during online learning. The responses are portrayed in Fig. 1(a), Fig. 1(b), Fig. 1(c) and Fig. 1(d) respectively. Response regarding academic performance during COVID-19 pandemic was mixed, since 26.82% learners felt that their performance decreased but almost equal number of learners 36.32% felt that their performance increased whereas 23.81% learners observed no-change in performance. It should also be noted that a significant fraction i.e. 23.06% of learners was not able to assess their performance in online mode of education. 55.89% learners felt that it was quite difficult to shift to online education abruptly whereas 44.11% learners easily adapted the online mode of education as shown in Fig. 1. When asked about whether study workload increased in online mode or not. 46.12% learners cannot decide, 41.85% students (30.32% agreed and 11.53% strongly agreed) felt that their study workload

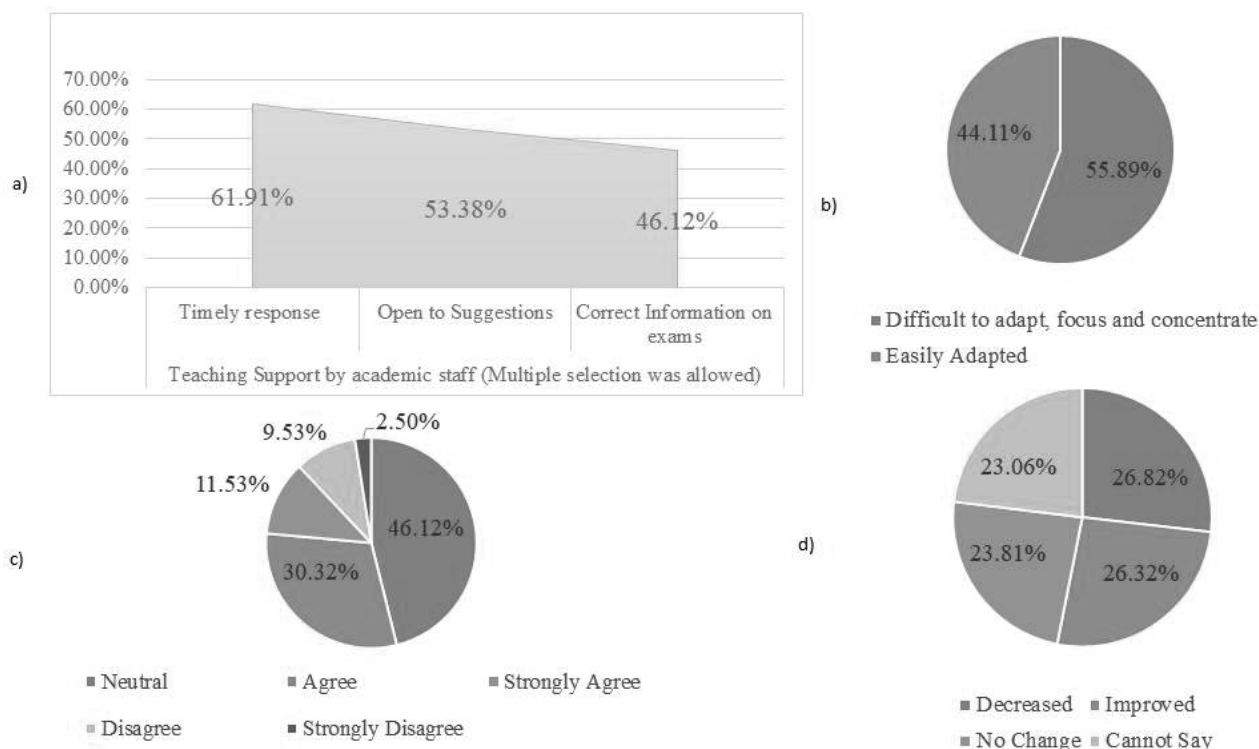


Fig. 1: Responses to questions :a) Teaching support during COVID-19 pandemic, b) Adaptability to online learning, c) Performance in online-learning, d) Study workload increased during online learning

increased during coronavirus pandemic. Only 12.03% felt that study workload not increased during pandemic.

D. Required Facilities at Home, Institute and Required Skills for Online Classes During COVID-19

A total of 8 questions across 4 categories namely device used, Internet connection, required software & skills and institute facilities were asked to assess the facilities required for online mode of education as shown in Fig. 2, 3, 4, 5. 85.71% learners had his/her device whereas only 14.29% borrowed a device to attend the online classes during pandemic. Smartphone is the most popular device 88.97%, followed by laptop 9.52%. Mobile GPRS is the first choice for the Internet connectivity since 75.18% respondents used it, Wi-Fi is the second choice as it was used by 20.30% of respondents. Broadband and leased line was used marginally. 39.35% respondents said that quality of Internet connection was satisfactory whereas only 7.77% reported that it was very good, 30.58% felt that it was good and 22.30% said that it was poor. When asked about required software, 70.68% learners had required software during both first and second wave of coronavirus,

while 12.23% learners had it during second wave only, 17.03% not had it at all. 34.58% learners reported that they learned required skills easily whereas 29.57% had previous experience of using such tools.

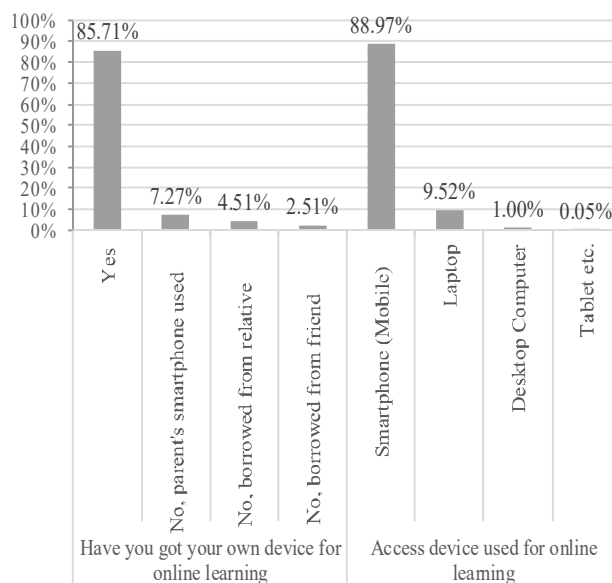


Fig. 2: Response to questionnaire based on access device and its availability

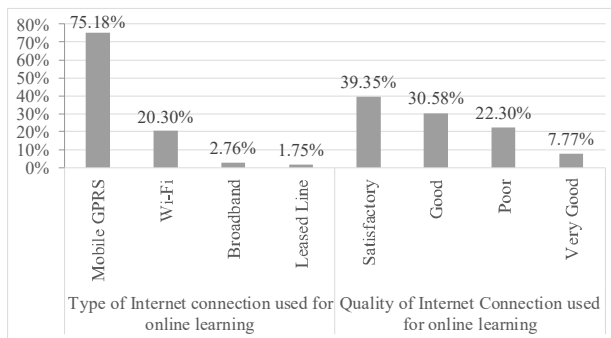


Fig. 3: Responses to questionnaire based on Internet connection used and its quality

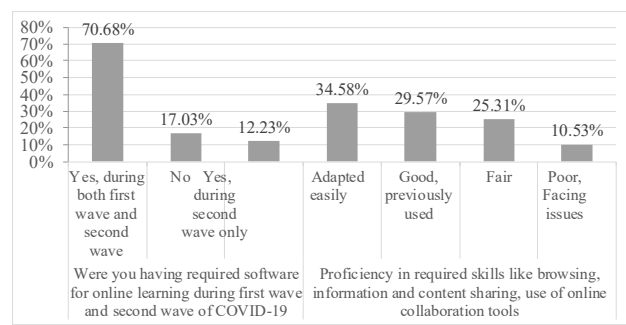


Fig. 4: Responses to the questionnaire pertaining to required skills

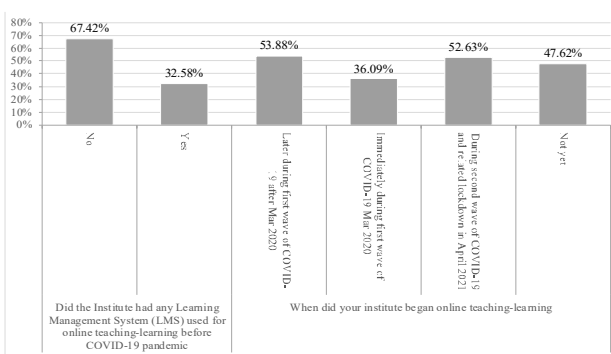


Fig. 5: Responses to the questionnaire based on Institute facilities

Fig. 5: Responses to the questionnaire based on Institute facilities

E. Social, Emotional and Personal Life

As shown in Fig. 6, we assessed social, emotional and personal life with the help of 6 questions. Wearing a mask was the most notable change (82.21%) in social manners followed by washing hands (66.92%) and leaving home unnecessarily (50.13%). It is important to note that 71.68% learners pronounced that they miss face-to-face teaching-learning. 70.43% learners were not having any prior exposure to online mode of education. This hints that all stakeholders think about restructuring and aligning online mode of education.

Which habit in you has changed during lock-down	Are you satisfied with Government agencies like UGC, AICTE etc. initiatives during lock-down	Did you have any prior exposure of attending online course before COVID-19	Emotional life during lock-down and online teaching-learning
	Yes 35.59%		Hopeful 32.33%
	Cannot say 38.60%	No 70.43%	Stressed 27.06%
Wearing a mask outside 82.21%	Washing hands 66.92%	Do you miss face-to-face teaching	Anxious 14.53%
		Yes 29.57%	Bored 16.79%
		No 17.29%	Depressed 9.27%
Leaving home unnecessarily 50.13%	Shaking hands 38.85%	Which issue bothered you most during lock-down	Concern about future education 17.29%
		Professional career and job in future 47.61%	Financial issues 14.28%
		Study related issues 20.80%	
	Yes 71.68%	Cannot say 11.03%	

Fig. 6 : Responses to questionnaire based on social, emotional and personal life during COVID- 19 pandemic

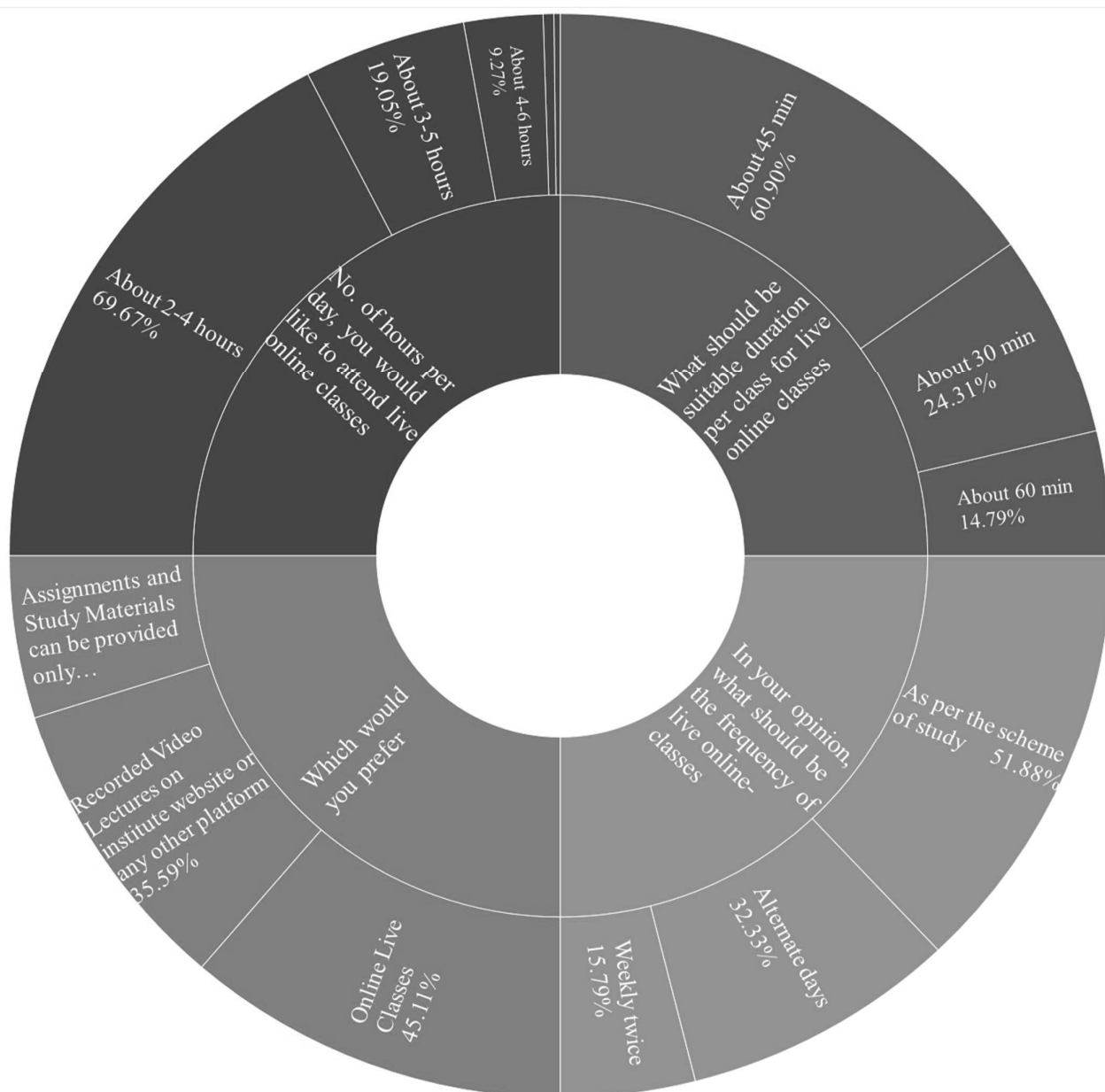


Fig. 7: Response to questionnaire concerning structure of online classes

F. Structure of Online Classes

Fig. 7 depicts the structural attributes of online classes. 45.11 % learners prefer online live classes whereas 35.59% learners opted for recorded video lecture. Regarding frequency of online classes, 51.88% learners want it as per scheme of study whereas 32.33 % liked it on alternate days. 69.97% learners think that only 2-4 hours of online classes are enough per day with most of them wants class duration of not more than 45 minutes.

G. Perceptions, Experience and Preference of Students

The Table 6 portrays the perception, experience and preference of students. About 69.92% (279) students felt that online learning was not equivalent to classroom learning. But surprisingly 68.67% students liked online exams. When asked about type of online exams, 48.37% prefer MCQs whereas 29.60% like subject short answers but 22.06% orated in favour of open book exams. Messaging service like WhatsApp

was preferred for query resolution by 62.91% students, followed by live chat, 32.07 %. E-mail stood as the least preferred way for query resolution. 224 students think that their technical skills improved whereas 175 do not think so. About 40% candidates deduced that completion of assignments takes more time in online mode whereas 41% students cannot decide over this. 35.83% students think that teachers were comfortable with online learning, 38.09% cannot say anything whereas 26% students reported that teachers were uncomfortable. 40.60 students cannot decide whether online learning is more flexible and convenience but 33.33% think it is more flexible. When asked about obstacle in online learning, lack of Internet connection (56.64%), data limit (65.66%), speed of Internet connection (67.17%) was pronounced against lack of face-to-face communication (47.62%), required technical skills (30.33), lack of access device (27.07%). Music (96.76%), yoga (69.57%), social media (59.20%) and household work (50.84%) were the most preferred way of stress buster during COVID-19. 296 students as against 103 students spoke-out that their adaptability increased during second wave than first wave. 265 versus 134 students said that second wave was more painful. Majority of students preached that online classes is not suitable for practical classes as well as theory classes like mathematics, coding.

Table 6 :
Perceptions, Experience And Preference Of Students

Questions	Response	N = 399	Percentage
Do you think that online teaching-learning was equivalent to physical classroom teaching	No	279	69.92 %
	Yes	72	18.04 %
	Cannot say	48	12.03 %
Do you like to attend online exams	Yes	274	68.67 %
	No	125	31.33 %
Which type of online exams, you would prefer	Objective (MCQs)	193	48.37 %
	Subjective - Short Answer	118	29.60 %
	Subjective - Open Books	88	22.06%
Which would you prefer most for clarifying queries	Messaging service like What's app	251	62.91 %
	Live Chat	120	30.07 %
	E-mail	28	7.01 %
Do you think that in online teaching-learning, it is easy to communicate with teacher	Yes	224	56.14 %
	No	175	43.86 %
Do you think that your technical skills has improved during online teaching-learning	Yes	224	56.14 %
	No	175	43.86 %

Online teaching-learning requires more time to complete given assignments	Neutral	163	40.85 %
	Agree	121	30.32 %
	Disagree	47	11.78 %
	Strongly agree	38	9.52 %
	Strongly disagree	30	7.52 %
Do you think that teachers were comfortable with online tools and platforms	Neutral	152	38.09 %
	Agree	125	31.32 %
	Disagree	72	18.04 %
	Strongly disagree	32	8.02 %
	Strongly agree	18	4.51 %
Do you think that online teaching-learning is more flexible and convenience	Strongly disagree	42	10.53 %
	Disagree	62	15.54 %
	Neutral	162	40.60 %
	Agree	77	19.30 %
	Strongly Agree	56	14.03 %
Do you think that online teaching-learning is more interactive and better to concentrate,	Strongly disagree	66	16.54 %
	Disagree	94	23.56 %
	Neutral	136	34.08 %
	Agree	61	15.29 %
	Strongly Agree	42	10.53 %
Do you think that online teaching-learning has instigated better self-discipline and a sense of responsibility	Strongly disagree	49	12.28 %
	Disagree	76	19.05 %
	Neutral	156	39.09 %
	Agree	73	18.30 %
	Strongly Agree	45	11.28 %
Which is obstacle? (multiple selection allowed)	Lack on Internet connection	226	56.64%
	Data limit	262	65.66%
	Speed of Internet Connection	268	67.17%
	Lack of face-to-face communication	190	47.62%
	Lack of access device	108	27.07%
	Required technical skills	121	30.33%
Which were your stress buster during COVID-19 (multiple selection allowed),	Music	289	96.66%
	Virtual Gaming	97	32.44%
	Social Media	177	59.20%
	Watching TV	118	39.46%
	Watching OTT content	87	29.10%
	Dancing	58	19.40%
	Cooking	143	47.83%
	Writing	103	34.45%
	Painting	75	25.08%
	Gardening	86	28.76%
	Singing	88	29.43%
	Household work	152	50.84%
	Indoor gaming	100	33.44%
	Physical exercise and/or yoga	208	69.57%
Did your adaptability increased from first wave to second wave of COVID-19 for online teaching-learning	Yes	296	74.19 %
	No	103	25.81 %
Which one was most painful for you?	Second wave of COVID-19	265	66.42 %
	First wave of COVID-19	134	33.58 %
Do you think that online teaching-learning is equally suitable for practical subjects and theoretical subjects	No	305	76.44 %
	Yes	94	23.56 %
In your opinion, is online teaching-learning suitable for Mathematics	No	207	51.88 %
	Yes	192	48.12 %

Do you think that online teaching-learning suitable for coding classes	Yes	220	55.14 %
	No	179	44.86 %
What do you think about the appropriateness of online classes for the Engineering Drawing/Engineering Graphics/Machine Drawing	Strongly disagree	93	23.31 %
	Disagree	90	22.56 %
	Neutral	146	36.60 %
	Agree	39	9.77 %
	Strongly Agree	31	7.76 %

5. Limitations And Future Scope

The presented study has three main limitations which are as under:

1. Although, we have mandated e-mail Id (Sign-in with G-mail required) in order to ensure that a single participant can submit the response only once. The survey was conducted through an electronic mode of participation and hence it is almost impossible to make it bias free.
2. Due to COVID-19 restrictions and time constraint, the presented study is bound to a single discipline i.e. engineering and to a specific geographical region. Although the respondents' dataset is balanced in the sense that it contains appropriate blend of respondents from different human settlement since 71 (42.86%) respondents are from urban settlement, 151 (37.84%) respondents are from rural settlement and 77 (19.23%) respondents belong to semi-urban settlement. Further research studies may be done focusing on multiple disciplines and to a wider geographical area in order to get a more generalized view of repercussions of online education.
3. The survey was conducted among students only, the first and foremost stakeholder of the education system. For a wider perspective, the future research studies may also include teachers, the second most important stakeholder of the education system.

6. Conclusion

To curb the spread of pandemic, most educational institutions have reacted hurriedly and made a transition from campus-based offline classes to online classes. Though online learning is not new, it is an established fact that its usage had shoot up after COVID-19 outbreak. We tried to consider online learning and its many attributes from learners' point of view. Our findings suggest that online live class was the most popular mode of online learning. Most of the engineering students easily adapted to online mode

and they were also satisfied with teachers' response. Smartphone and mobile GPRS were the most popular combination for online learning. Any online learning system must consider smartphone compatibility to provide better experience. 71.68% Students missed face-to-face communication during pandemic. Infrastructure for internet connection has to be improved many folds, particularly the mobile GPRS since most students used smartphone and mobile GPRS for attending online education. Our study observed that majority of the students prefer 3-5 classes per day 45 minutes' duration. 69.92% students opined that online learning is not equally effective as physical classes. 76.44% students surmised that online classes were not suitable for practical classes. Our study suggest that successful online learning requires digital infrastructure of our country to be improved many folds since lack, speed, data limitation were the main reasons for disturbances in online learning. The results of our study can play an important role for better tuning of online teaching-learning because even after COVID-19 pandemic will be over, education system can never return to its pre-pandemic state.

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