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COVID-19 and its implications on students' learning behaviour

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ABSTRACT

Due to the outbreak of COVID-19, the educational institutions in India suddenly switched to online mode of teaching. This new learning mode gives the flexibility to connect at any time from any place. This sudden shift has impacted the learning behaviour of students to a large extent, which is studied and analysed in this paper for a computer programming course. An online questionnaire is prepared and circulated among the students for which 158 responses were received. Based on the responses, it is found out from the analysis that 75.32% of students favour learning this course in offline mode while 48.1% favour the virtual mode. The maximum support for the classroom teaching is evident from the data which shows that 98.73% students find the teacher's competency good in offline mode, 98.1% find teacher's content delivery effective in offline mode and 79.75% are of the view that possibility of frequent interaction is more in offline mode, whereas 87.97%, 85.44% and 42.41% of students are congenial with the online mode in terms of same parameters. Also, 69.62% of students are comfortable with offline mode, while 55.06% with online mode. For evaluation mode and pattern of question paper, 78.5% favour online mode of evaluation with a mix of multiple-choice questions and coding questions. It is irrespective of their preference to offline mode for teaching-learning. In the end, some recommendations are proposed based on the analysis to improve the teaching-learning methodology during the time of crisis.

Keywords: education, COVID-19, online teaching, offline interaction, teaching-learning, lockdown, educational technology; student perception.

INTRODUCTION

World Health Organization (WHO) has declared COVID-19 a pandemic which has badly affected the global economy. The sudden outbreak of COVID-19 has affected the education sector worldwide. Many educational institutions are forced to shut down, which has impacted a large fraction of world's student population. Since face-to-face teaching-learning cannot take place in this time of crisis, the situation has led to forced resortation to online-learning or e-learning (Dhawan 2020). It is defined as "all forms of teaching and learning where the student and instructor are separated geographically and temporally" (Finch and Jacobs 2012). There are several initiatives taken by the Ministry of Education (MoE) to help the students

cope with the loss caused by the interruption of classes due to lockdown. Repositories of thousands of online courses are made available to the students free of cost (ETGovernment 2020). A number of online portals or platforms are offered for e-learning like e-pathshala, NPTEL, SWAYAM (study webs of active learning for young aspiring minds), COURSERA, NIOS (National Institute of Open Schooling), NROER (National Repository of Open Educational Resources). Another initiatives by MoE are Massive open online courses (MOOCs), virtual labs, FOSSEE (open source software for education), e-yantra (robotics education) and spoken learning programmes.

The regulators like UGC, NCERT, AICTE have passed the directives to the schools and higher educational institutions to continue the pending course curriculum via online mode (Singh and Thurman 2019). Information technology plays a vital role (Todorova and Bjorn-Andersen 2011). There are various virtual platforms which are being used by the various institutions like Google classrooms, Google Meet, Zoom, Cisco Webex, Microsoft Teams. There are two ways into which online learning can be categorised, synchronous learning and asynchronous learning. While asynchronous learning is not structured (Littlefield 2020), synchronous learning gives the flexibility of live interaction with the instructor (Gua 2020).

But the challenges associated with the online teaching-learning cannot be overlooked (Kebritchi, Lipschuetz, and Santiago 2017). First challenge is of accessibility. Providing access of online teaching-learning to rural and remote areas is difficult with poor internet connectivity and network reliability. Another challenge is of adaptability. The adaptation to technology is equally important in virtual mode of learning. The learners as well as the instructor should be comfortable with the virtual online platform being used for teaching-learning. Affordability is another challenge. The virtual teaching-learning environment should be designed in such a way that it is user-friendly, affordable, flexible so that life-long learning can take place with the development of new skills by learning from anywhere anytime (Affouneh, Salha, and Khlaif 2020).

In this paper, the learning behaviour of students is analysed in the two modes of teaching-learning, online mode and offline mode during COVID-19. A programming course titled Computer Programming II is considered to carry out this behavioural analysis. This course includes computer programming with arrays, functions, structures, file handling concepts and more. The undergraduate students studying this course were given an online questionnaire to which 158 responses were received. The questionnaire covers all the aspects related to the

preferred mode of learning this course, preferred mode of evaluation, duration of the course, assistance to doubts clearance, content delivery and students' comfort and interest level. Based on the responses, the comparison between the two modes of teaching-learning is performed considering the above-mentioned factors. The suggestive measures to improve the course delivery in online mode of teaching are also discussed.

LITERATURE SURVEY

There are a number of studies in literature that report the introduction of online teaching-learning in different fields of education.

The COVID-19 pandemic has forced the schools, colleges and universities across the world to conduct the classes and activities remotely. The transition of classes from regular face-to-face teaching to the virtual online teaching presented several challenges for both learners and facilitators. (Parkes, Stein, and Reading 2015) conducted a study to ascertain whether the students are prepared for the new e-learning environment or not. A survey is carried out to analyse the familiarity of students with virtual platforms and digital tools. (Singh, Rylander, and Mims 2012) compared the efficiency of students in studying the courses in the two modes, that is, traditional classroom method and online method. For the online mode of teaching also called emergency remote teaching to be effective for the learners, the role of instructor or facilitator is also important and is emphasised in (Martin 2020). The optimization of online teaching requires five key points to be attained by the educator. It is emphasized that the instructor should keep motivating the students and should maintain good interpersonal relationship with the students for a fruitful learning. With online teaching, the need for prepared online teachers arises which is discussed in (Brennan et. al 2014). The faculty who were earlier taking face-to-face classes need to shift all of a sudden to online teaching. Due to lack of training and support, it becomes difficult for the faculty to transfer face-to-face strategies into the digital classroom. (Cross and Polk 2018) suggests the approaches to be used to train the faculty for managing the online classrooms. Online learning can be made successful by the blending of digital tools with personal support. (Dunbar 2018) has done a comparative analysis of teachers' performance in offline and online mode of teaching.

Different universities across the world have adapted their courses for the emergency remote teaching due to the coronavirus pandemic. (Fox et al. 2020) has shared their experiences while preparing for the remote teaching of laboratory courses. The motivation, learning goals

and challenges faced are also discussed. (Balasopoulou et al. 2017) has explored the potential of e-learning in ophthalmologic education. For sustaining ophthalmologic learning, online resources are used and the course is made interesting to the students. The same has been discussed for entrepreneurship education in (Liguori and Winkler 2020) and medical education in (Agarwal and Kaushik 2020). The learning behaviour of resident doctors is predicted with the help of the responses received from them. (Abbasi et al. 2020) has recorded the students' perceptions to make a decision on induction of online teaching in medical curriculum. The analysis of strengths, weaknesses, opportunities and threats (SWOT) for introducing e-learning into the university curriculum is performed in (Cojocariu et al. 2014). (Galletly and Carciofo 2018) has demonstrated the importance of online discussion forums (ODFs) for business students which is used as an effective platform for sharing opinions. The measures for the effective use of ODFs in the course curriculum are also suggested. (Basilaia 2020) has performed a comparative analysis of the products offered by Google for virtual teaching, for example, Meet, Classrooms, Calendar, Gmail, Drive and Forms. These are tested for implementation. The literature has also seen number of researchers who has favoured remote teaching-learning in case of natural disasters, calamities and pandemic. (Ayebi-Arthur 2017) promoted the use of online teaching post earthquake in New Zealand in 2011. The impact of school closures post-earthquake on the students' academic performance and student dropout rate is discussed in (Di Pietro 2018). The role of e-learning after the disruption of learning environment is promoted in (Wilkinson et al. 2013) along with the strategies for its successful implementation.

Thus, it is clear from an extensive literature survey that information and communication technology (ICT) play an important role for sustaining the education in times of need.

MATERIAL AND METHODS USED

In our university, January marks the start of a new semester, semester-II, in which the course of Computer Programming was offered to first year students. The classes for this course were going on as usual with the offline face-to-face method when lockdown was announced due to COVID-19 pandemic in the month of March. The lockdown led to the closure of the university for an indefinite time. In this crucial time, sustaining the education is the biggest challenge for the university Deans, heads of departments and faculty. Online teaching so named as emergency remote teaching come to the rescue to all. A number of workshops, faculty development programmes were teaching organized by the respective departments in

order to train their faculty. The usage of all the features of a number of virtual platforms such as Zoom, GoTo Webinar, Google Meet, GoTo Meeting, Cisco Webex Meetings were demonstrated to the faculty for efficient online course delivery.

For the course of computer Programming II, the classes were resumed via online mode through Zoom platform. The coding practice sessions were held on the coding platform code-quotient. The lecture recordings and other course materials were shared to the students through Chalkpad, which is the university ERP platform. Live chats, WhatsApp or email is used by the instructor to provide assistance to the students having doubts. The evaluation of this course consists of multiple-choice questions on online Myanatomy platform along with coding test questions on code-quotient. The sudden shift from face-to face classroom teaching to online digital teaching during COVID-19 has affected the students' learning behaviour which is addressed in this paper for a programming course. The analysis is carried out whose results are presented in the next section.

RESULTS AND DISCUSSION

Students' perception about offline and online mode of teaching-learning process due to COVID-19:

- *In terms of teacher's competency level (CL) and content delivery level (DL):*

Firstly, students' responses are recorded on a five-point scale (Preedy and Watson 2010) for evaluating the teacher's competency level (CL) and his content delivery level (DL) in the offline and online modes of teaching. The responses are taken for the course of Computer Programming II and are listed in Table 1.

Table 1: Students' responses for evaluating the teacher's competency level (CL) and the content delivery level (DL) in online and offline teaching modes.

Five-point scale	Number of Students' Responses			
	CL-Offline	CL-Online	DL-Offline	DL-Online
Poor (1)	1(0.6)	7 (4.4)	2(1.3)	9 (5.7)
Fair (2)	1(0.6)	12 (7.6)	1(0.6)	14 (8.9)
Good (3)	42(26.6)	52 (32.9)	37 (23.4)	45 (28.5)
Very good (4)	62(39.2)	55 (34.8)	66 (41.8)	64 (40.5)
Excellent (5)	52(32.9)	32 (20.3)	52 (32.9)	26 (16.5)

Out of the total of 158 students who participated in the online survey, 156 students (98.7%) find that the teacher's competency is fairly good while 2 students (1.2%) responded for poor teacher's competency in the offline mode. This number stands at (n=139, 88.0%) and (n=19, 12%) in the online mode.

While comparing the teacher's content delivery level in the two modes, (n=155, 98.1%) students think that teacher's content delivery is quite good in offline mode and (n=135, 85.5%) feel the same for online mode. (n=3, 1.9%) and (n=23, 14.6 %) of students are of the view that the content delivery of teacher is poor in offline and online mode respectively.

Thus, majority of students favoured the offline mode for teacher's competency and content delivery. Since it is a programming course, therefore teacher's competency and content delivery level are not affected much due to switching from offline mode to online mode and achieved better students' satisfaction irrespective of physical separation.

- *In terms of students' perception level (PL) and comfort level (CL)*

For learning the course of Computer Programming II in the two modes, namely online and offline, the students' perception level and their comfort level responses are listed on a five-point scale in Table 2. Here, PL and CL are related to their adaptation to the two modes due to pandemic. It depends on number of other factors like student's interest in learning the course, availability of learning resources and well-equipped technical support.

Table 2: Record of students' perception and their comfort level on a five-point scale for offline and online mode.

Five-point scale	Number of Students' Responses			
	PL-Offline	PL-Online	CL-Offline	CL-Online
Strongly disagree (1)	1 (0.6)	15 (9.5)	3 (1.9)	5 (3.2)
Disagree (2)	5 (3.2)	17 (10.8)	5 (3.2)	18 (11.5)
Neutral (3)	33 (20.9)	50 (31.6)	40 (25.3)	46 (29.5)
Agree (4)	46 (29.1)	50 (31.6)	65 (41.1)	54 (34.6)
Strongly agree (5)	73 (46.2)	26 (16.5)	45 (28.5)	33 (21.2)

(n=119, 75.3%) students favoured the offline mode of teaching while (n=6, 3.8%) students disagree with this traditional learning method. (n=33, 20.9%) students were neutral in their feedback. For online teaching, (n=76, 48.1%) students responded in its favour while (n=32,

20.3%) students do not agree with this virtual classroom teaching and (n=50, 31.6%) were neutral.

As far as students' comfort level for learning this course is concerned, (n=110, 69.6%) students are comfortable with offline mode and (n=87, 56.8%) students find ease in learning this course online. (n=8, 5.1%) and (n=23, 14.7%) students do not like learning this programming course offline and online respectively.

It is clear from the above data that the majority of students are inclined towards traditional classroom learning. Online teaching is not favoured by them may be due to slow adaptation to the new system of learning or technology. Other factors include less familiarity with the virtual tools, difficulty in accessing the live sessions due to poor connectivity and lack of required resources.

- *In terms of students' interaction level (IL) with the instructor*

The data obtained from the students' responses on the level of interaction with the instructor in the two teaching modes is plotted on a five-point scale in figure 1.

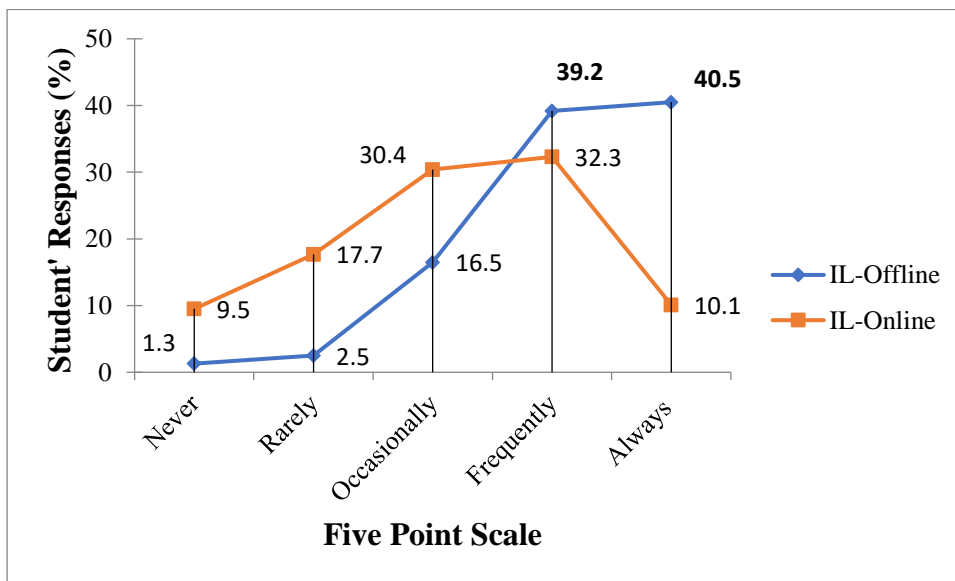


Fig. 1: Responses for students' interaction level (IL) with instructor

It is clear from fig. 1 that 79.7% students believe that there is a possibility of frequent interaction with the faculty in offline face-to-face classroom teaching. 3.8% students think that interaction between student and instructor take place very rarely in offline mode while 16.5 % students feel that the interaction takes place occasionally. Whereas in online teaching mode, this value scales up to 27.2% students who think hardly any interaction takes place

between facilitator and the learner. 42.4% of students responded for frequent interaction and 30.4% for occasional interaction in online mode of teaching-learning.

This trend indicates more possibility of interaction in offline mode which is due to the ease of approach to instructor, easy and frequent doubt-clearing assistance whereas in online mode, such kind of frequent interaction with the instructor and hands-on practice sessions are difficult. That's why (Holbeck and Hartman 2018) have emphasized the need to learn the tools which establish social presence in online class like Loom, Flipgrid, Remind, Escape Room and Digital Breakout.

The overall mean score for the parameters CL, DL, PL, CL and IL are presented in figure 2.

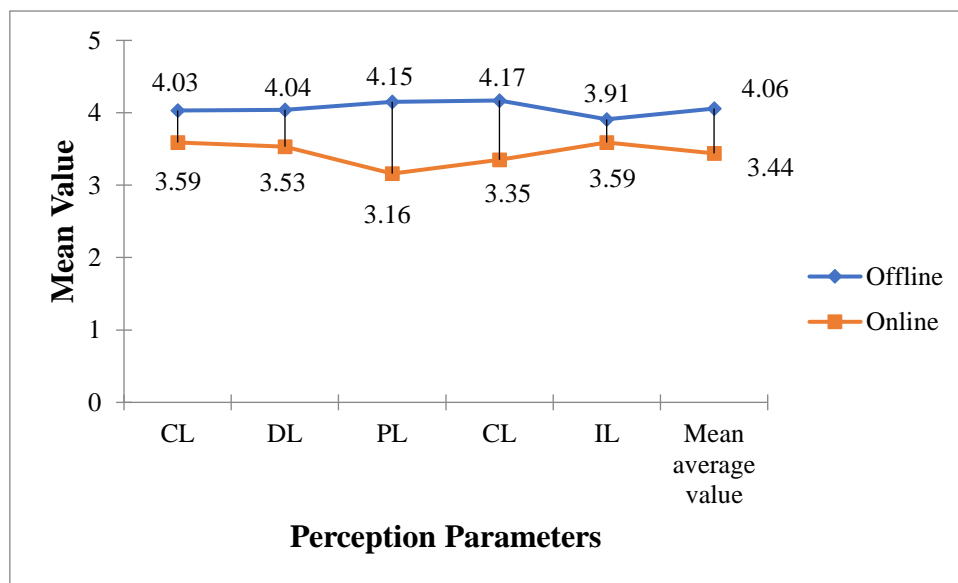


Fig 2: Mean response versus the perception parameters

Surprisingly, being a programming course, the mean value magnitude for offline mode is higher than online mode. This clearly indicates the preference of students to learn this course through offline mode (blue line) over online mode (orange line). The average mean value score for offline mode (4.06) and online mode (3.44) also favour the above findings.

Students' perception on class duration, doubt clearing assistance and study material provided in online mode of teaching:

The bar diagram in fig. 3 contains the students' responses related to the online class duration, doubt clearing support and type of study material provided by instructor.

From the figure it is clearly visible that majority (n=89, 56.3%) students favoured 45 minutes class duration for the online mode. However, (n=53, 33.5%) and (n=15, 9.5%) students

favoured one hour and 30 minutes class duration respectively. Only (n=1, 0.6%) student favoured more than one-hour class duration. (green horizontal bars).

During lockdown students are provided with recoded video lectures, reading material through university ERP system and coding practice session on virtual platform. Figure 3 shows that majority (n=101, 63.9%) of students are of the view that recorded video lectures along with study material is sufficient. (n=41, 25.9%) students feel that coding practice sessions on virtual platform is sufficient for this course while (n=6, 3.8%) and (n=10, 6.3%) students think that reading material and recorded lecture are sufficient respectively (orange horizontal bars).

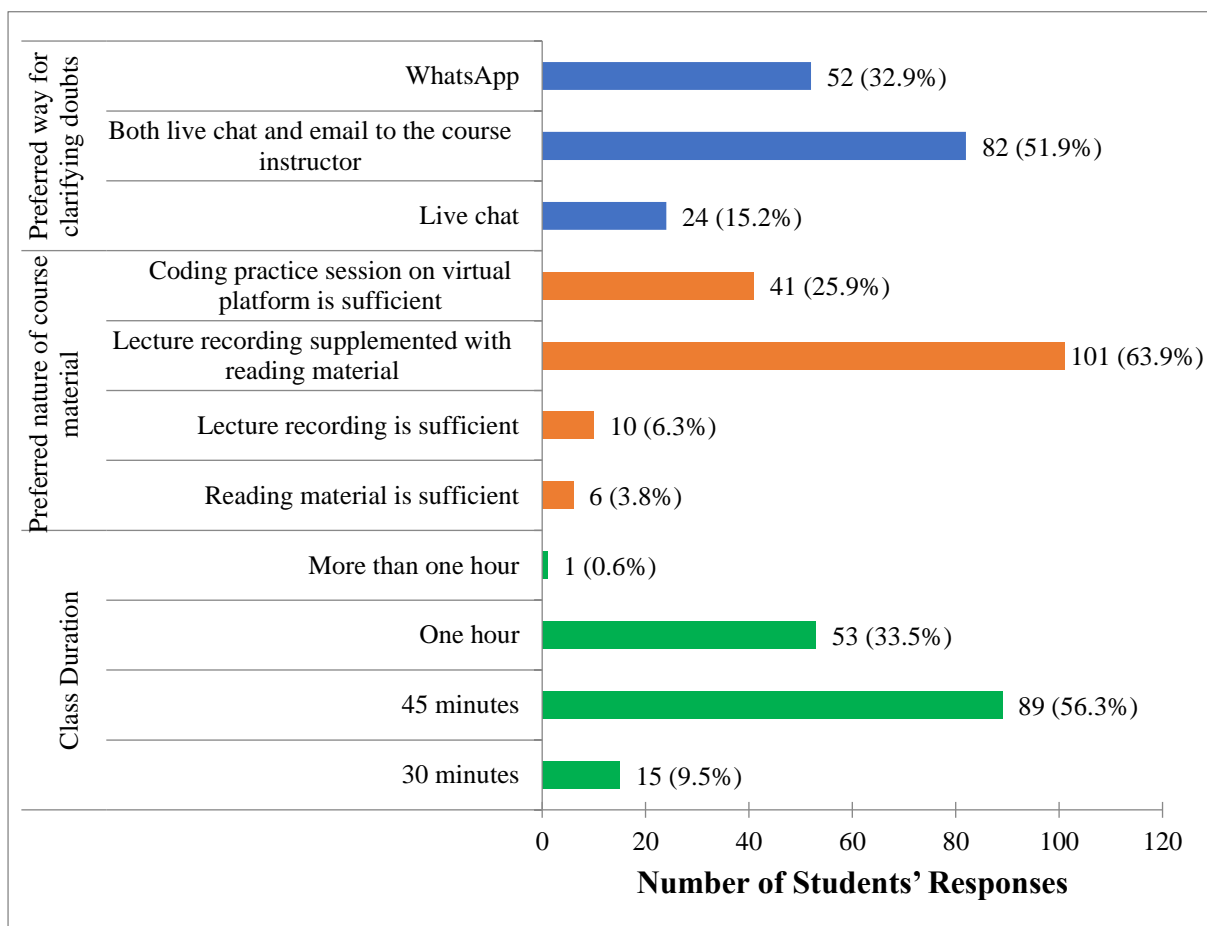


Fig. 3: Students' responses related to class duration, assistance to the course material and doubt clearing assistance in online teaching mode.

In online mode, students' doubts are clarified either through live chat during lecture, or through email or WhatsApp after online class session is over. (n=82, 51.9%) students favour the option of live chat and email to the instructor, (n=52, 32.9%) favour doubts clearing

assistance provided through WhatsApp and remaining (n=24, 15.2%) opt for only live chat to clarify their doubts (blue horizontal bars).

Thus, it is clear from the above data that majority of students are in favour of 45-minutes class duration with doubts clearing assistance provided through live chat and by e-mailing to the instructor. The preferred way of providing course material is through lecture recordings along with the study material.

Students' perception on the difficulty level of the course and their interest in learning the course:

For the course of Computer Programming II, the students' responses related to their interest in the subject and difficulty level of the subject is presented in figure 5.

In case of difficulty level, only 46.2% students found this course moderate, whereas about 43.7% found it hard. While 6.3% of students have opinion that it is very hard to learn, very few 3.8% students found this programming course easy (blue horizontal bars).

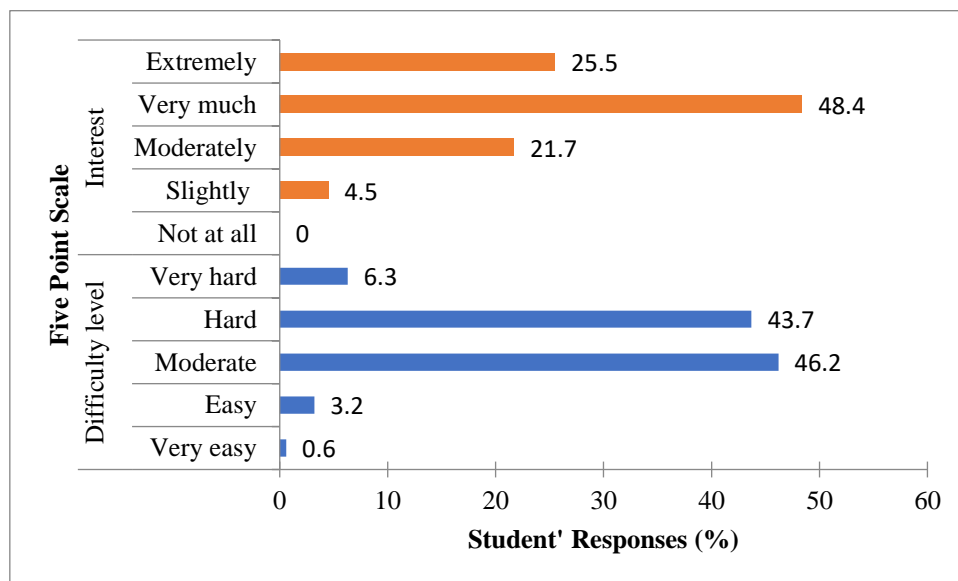


Fig. 5: Responses of students for the interest level and difficulty level in learning Computer Programming II course.

As far as students' interest is concerned, 73.9% students are very much interested in this subject while 4.5% students did not find this subject interesting. 21.7% students have moderate interest level in this course (orange horizontal bars).

Thus, it can be concluded that 50% (43.7%+6.3%) students find this course difficult in online mode which can be related to low competency level and course delivery in online mode as discussed in table 1. Other reasons can be lack of peer group learning in online mode and lack of clarity of concept due to limited lab practice sessions as compared to that in traditional classrooms.

Students’ perception about evaluation mode:

Both online and online modes of evaluation have gained popularity in engineering and other scientific disciplines all over the world (Hewson et. al. 2007) (Groen and Herry 2017). COVID-19 pandemic has restricted us only to online mode of evaluation. Students opinion in this context are also recorded and listed in table 3. This will further help to improve the evaluation process if same situation continues in the next semester. For evaluation mode and question paper pattern, (n=124, 78.5%) of students favour online mode with the pattern of question paper to be a mixture of multiple choice and coding questions for this course. The remaining students (n=34, 21.5%) favour offline mode with multiple-choice type question only. No one is interested to include only coding questions in the paper.

Table 3. Students’ responses about evaluation mode and question paper pattern

Evaluation Mode	Students’ Responses n (%)	Question paper Pattern	Students’ Responses n (%)
Offline	34 (21.5%)	Multiple choice type (MCQs)	34 (21.5%)
Online	124 (78.5%)	Coding questions only	0
		Mix of MCQs and coding questions	124 (78.5%)

Thus, it is clear that the maximum percentage of students favour online mode of evaluation and in their opinion the question paper should contain multiple-choice questions and coding questions. It is irrespective of their preference to offline mode for teaching-learning over the online mode.

To summarize, it can be said that students feel more involved in offline face-to-face learning environment. That is why they supported the offline mode for teaching-learning even for a

programming course. This shows that students are not congenial to learn in environments which restrict their freedom of expression. But for evaluation purpose they prefer online mode because of the possibility to score more with multiple choices. Also, you are relaxed in your own personal space with no proper proctoring. Huge variations in results are observed when evaluation is conducted in a proctored offline environment compared to the unproctored online mode (Hollister and Berenson 2009).

CONCLUSIONS AND SUGGESTIONS

This paper analyses the learning behaviour of students in the two teaching-learning modes, namely, traditional classroom teaching and the virtual online teaching for a computer programming course. Due to COVID-19 pandemic and subsequent lockdown, this course was all of a sudden shifted to online mode from the classroom mode of teaching. To analyse the change in students' behaviour, an online questionnaire was shared with total of 170 students studying this course out of which 158 responses were received. From the responses, it is observed that 75.32% of the students are in favour of offline teaching while 48.1% supported online teaching. Further, 79.75% of students feel that the interaction between teacher and the student is better in classroom teaching because of an obvious ease of approach to the teacher. While 98.73% of students believe that the competency of teacher is far better in offline mode with good content delivery (98.10%). As far as the comfort level of students is concerned, 69.62% of students are comfortable with classroom teaching. But considering the current scenario where India has reached second position in the world tally of the COVID infections, online teaching-learning is the only means to sustain the education in this time of crisis. Online teaching can be made effective when the following suggestive measures are incorporated into it.

- Instructor as well as the learner should be made familiar with the usage of virtual platform and its features.
- Since physical interaction is missing, so more efforts should be put in making the course presentations for better understanding.
- More discussion is recommended during online class for better course delivery.
- The faculty should be calm, easy going and should maintain good relationship with their students in virtual environment.
- The facilitator should ensure happy learning and report any mental health issue faced by the student.

- The class size should be of 30-40 students for better interaction.
- Innovative teaching ideas should be explored to engage the students in online class and team learning or group learning should be encouraged.
- For better understanding of a programming course, some coding practice sessions or learning by doing sessions should be organized on various available coding platforms.
- Provision of voice-over PPTs should be offered as due to the unavailability of internet downloading the complete lecture becomes difficult (Mohammed et al. 2020).

Although, the closure of universities and institutions has forced the students to switch to digital classrooms but majority of them are still in favour of face-to-face classroom teaching. The current pandemic situation has created a wave of chaos and tension and therefore it is important for the students to learn and adapt to the available technology. The government and the university should provide all kind of support and training to the facilitators as well as the learners for effective teaching-learning. Thus, it is the need of the hour to adapt to the changes and to adjust to any form of delivery mode.

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