Are Indian Universities Ready for Online Teaching? Determining the Factors for Policy Making

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Abstract

Corona virus pandemic which hit the world in late 2019 led to the closing down of schools and colleges across countries and teaching-learning shifted to a digital model. In absence of any policy in place for such digital transformation of education, the shift was haphazard. Even today uncertainty persist over the reopening of educational institutions and we see that online teaching is going to continue in the near future. To add to this, recently, University Grant Commission (UGC) of India passed an order which allows colleges and universities to continue their class in hybrid mode even during normal times. Therefore, colleges and universities need a proper plan of action for the successful implementation of online teaching. In this quest, we conducted an online survey among the college-going students of University of Delhi, India to know the probable course of action in policymaking if hybrid mode of teaching becomes mainstream in the future. Our study shows that more than 50% of students are either fully dissatisfied or somewhat dissatisfied with online teaching. Ordered probit estimates suggest that teacher's ability to take online classes, availability of study materials, and access to high-speed internet play a crucial role in students' satisfaction. This indicates that regular training of teachers and keeping them up to date with latest technologies, timely availability of user-friendly reading materials downloadable/watchable in low bandwidth should be given utmost importance while making policy for online teaching. We also identify that students with greater exposure to social media tend to be more satisfied as students with higher exposure to social media possess greater social capital. Conversely, a damaged device can lower the overall experience of online teaching. These two results suggest that the policy of introduction of a common virtual platform for students and of borrowing laptops/tablets can enhance the experience of online learning of the students who lack social capital and properly functional device.

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1. Introduction

It was at the beginning of May 2021. There was mayhem everywhere in India. The entire country was grappling with the devastation of 2nd wave of COVID-19 pandemic showing no sign of slowing down anytime soon. The vaccination program was slow due to a shortage of supply and economic activities stood still. All the schools and colleges were shut down. Almost all the secondary (10th) and higher secondary (10+2) boards across states had cancelled their final examination. There was widespread fear in academia in reopening of schools and colleges or conducting final examination anytime soon in a populous country like India where the health infrastructure is dwindling. This prolonged closure of educational institutions may lead to a colossal economic loss of the country's future earnings which World Bank has estimated to be a loss of US$400 billion[1].

In this uncertain situation, many schools, colleges, and universities have shifted to a virtual mode of teaching. Various online platforms like Google Meet, Zoom, Microsoft Teams, WhatsApp, and others are widely used to teach online and circulate teaching materials. Adapting to this virtual mode of learning and teaching has been a challenging task for students and teachers. New challenges arrive every day both for students and teachers which were nonexistential in the traditional mode of teaching. The success of conducting virtual education came with some compromises done at both institutional and personal levels like delaying of admission in new academic years, reduction in the syllabus, shortening the length of the semester, cancelation of summer and winter breaks, mental breakdown of students and many others.

Online teaching is not a new phenomenon (Kopp et al., 2019; Leszczyński et al., 2018). Mostly online teaching was concentrated in developed countries as an *alternative/good-to-have* option to *traditional face-to-face* learning (e.g. emergency e-learning was introduced in the US in 2009 during the H1N1 threat and a substantial part of contingency plans had online classes as a substitution for traditional face-to-face classes (Allen and Seaman (2010)). Online teaching has always been viewed as a *good-to-have* alternative but is not given a serious effort to make it mainstream (Ribeiro, 2020). However, this *good-to-have* narrative changed immediately due to the onset of the covid-19 pandemic. Covid-19 pandemic initiated the process of digital transformation of teaching and as a result of crisis response, the almost entire world adopted the online mode of teaching hurriedly in compulsion. The migration from *traditional face-to-face* teaching to online teaching came with many logistical challenges and it brought changes in the attitude of administrators, teachers and students on the significance of online learning ((Ribeiro, 2020)). Cameron & Green (2019) argued that the process of digital transformation of teaching requires appropriate strategic preparation, building trust, thinking in the process, collaborative and organizational knowledge.

Therefore, digital transformation of teaching in higher education can be considered as an integration of all digital processes needed to achieve a transformational process that gives higher academic institutions the

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[1] https://www.hindustantimes.com/india-news/school-closure-over-covid-19-may-cost-over-usd-400-billion-to-india-world-bank/story-hxzbNLnXV46hi0bPyOvfVJ.html

opportunity to optimally and proactively apply digital technologies (Kopp et al., 2019). Prensky (2001) argued that contemporary students and faculty members are digital natives and they are expected to be tech-savvy. However, a significant proportion of teachers and students are not digital natives (Bennett et al., 2008)). Therefore, digital transformation of teaching would be a tricky process in many of the developing countries where the countries lack in required technological infrastructure, a part of students and teachers are digital natives and a substantial part of students and teachers are not. In this current situation, many countries were unprepared for the complete digital transformation of teaching and India is one of the classic examples. Indian universities too adopted an online mode of teaching like many other countries in a hurry and without any proper planning. We notice at every stage of online teaching, there is a lack of preparedness (Sahoo, 2020; Rahman, 2021). For instance, teachers are not well trained and unaware of the latest technologies; unavailability of good-quality study materials; insufficient broadband coverage (wired and wireless), etc.

The backbone of online education is the availability of high-speed internet. Though the number of broadband users has increased substantially to 757.61 million (wireless: 734.26 million and wired: 22.67 million) over the years with a growth of 1.36% per month[2], but coverage of 4G network and wired broadband is not uniform across all parts of the states. India's broadband service is mostly dependent on the availability of a 4G network. Studies indicate that the minimum speed required for experiencing a seamless online class is around 3 Mbps. Telecom Regulatory Authority of India (TRAI) reports indicating that India's average wireless broadband speed is only 4.23 Mbps with a standard deviation of 4.84 Mbps[3]. A wide variation in wireless broadband speed is also observed across states[4] and networks. This indicates that substantial parts of Indian states do not have access to high-speed wireless internet service. Experience of online learning in those parts of the states will be affected severely due to poor internet speed. This may raise a serious concern about equity in access to learning.

When India is getting ready to tackle the 3rd wave of the covid-19 pandemic, no one has any idea when the traditional mode of learning will resume. It seems that the virtual mode of teaching-learning will continue in near future. Recently, University Grant Commission (UGC), India, has passed order no. 1-9/2020 (CPP-II) dated 20th May 2021 which states that colleges and universities may take 40% of their syllabus through online mode. Therefore, even in the absence of a pandemic, universities and colleges may shift part of their teaching to online mode. When we are aiming for a future where both online and offline mode of teaching is going to coexists, it is very important to know, whether students are satisfied with online mode of teaching and what determines their satisfaction level in online learning. All these questions has remained unanswered while Indian universities are getting ready to continue upcoming academic years in virtual mode or plan for a hybrid mode of teaching. At present, there is no such policy in place for proper implementation of online

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[2] https://www.trai.gov.in/sites/default/files/PR_No.16of2021_0.pdf (Source: TRAI reports)

[3] Source: TRAI reports. https://myspeed.trai.gov.in/ for raw data. Figures are estimated by authors from TRAI raw data.

[4] Estimates are available of reasonable request. These estimates are from the month of April 2021.

classes at University level which can also ensure an inclusive learning environment for the students where no student is left out from learning or from getting a similar level of experience.

In this context, we carried out our study to search for the factors that affect a student's satisfaction level from online teaching. Here, we have briefly explained the conceptual framework of this study which tells us that student's satisfaction with online teaching is majorly dependent on the factors like availability of adequate technological infrastructure, efficient use of technology, user's exposure to the internet, condition of the device which is used to attend online class, etc. High-speed and uninterrupted internet service (wired and wireless) can provide a seamless experience to the students, whereas a damaged device might lower the overall experience of online teaching. Furthermore, students having longer exposure to the internet may have a better overall experience of online teaching as the social capital of those students is higher than their counterparts. However, since in this mode of teaching students have limited scope of direct interaction with the teacher and limited access to resources like textbooks, reference books and notes, therefore, teacher's ability to conduct online classes efficiently and timely availability of relevant electronic reading materials becomes the most important factors of student's satisfaction level. Even when all the above mentioned conditions are satisfied, the condition of the household such as availability of separate study room, number of household members during online class may also affect the student's satisfaction level as students are attending class from their respective homes. The satisfaction level of a Student with a separate study room at home may be higher. Whereas, presence of more household members during the time of online class may lower the overall experience.

In order to identify above factors, we conducted an online survey among the college going students of the University of Delhi between October 2020 to January 2021 to know how satisfied students are in the online mode of learning and what determines their satisfaction. Since our dependent variable i.e. student's satisfaction level of online teaching is ordered in nature, we used the ordered probit model to estimate the effects of these factors on student's satisfaction levels. Following the conceptual framework, our analysis should reflect a positive association between a student's satisfaction level and factors like teacher's ability to take online classes, availability of appropriate reading material, internet speed, exposure to the internet, and availability of separate study room at home. However, damaged devices, presence of more members at home during class may negatively impact the overall experience of online teaching.

Some of our results may help in developing a policy of online teaching at the university level. This analysis suggests that teacher's ability to take online classes and availability of reading materials are the two most important factors of satisfaction in online teaching. Similarly, high-speed internet is positively associated with the satisfaction level of online teaching. These results indicate that proper training of teachers, keeping them up to date with the latest and upcoming technologies and preparing relevant and user friendly reading materials (reference books, notes, audio/video lectures) which can be downloaded/watched in low bandwidth, should be the key focus of Universities when preparing a policy for online teaching. We also

find that higher exposures to social media have a positive impact on satisfaction level from online teaching. This could be because students with longer exposure to social media have more *social capital* than others and hence, these students are better connected with other students and teachers which enhances their experiences of online teaching. On the contrary, this analysis also suggests that the damaged devices are negatively linked to satisfaction level. In this regard, a university could think of a policy of *"borrowing laptop/tablet"* to facilitate the experience of teaching for the poor students. We also notice that some exogenous factors like having a separate study room at home and the presence of fewer members at home during the time of class are positively related to a better satisfaction level of online teaching. Though these factors do not have direct implications in policy formulation *per se*, but it is important from a student's perspective to take optimal decision.

2. Data and Methodology

2.1. Data

To carry out this exercise, we conducted an online survey among college going students[5] of the University of Delhi which is one of the largest universities in India. Survey responses were collected using *"Google form"* over a period of 4 months i.e. from October 2020 to January 2021. We used social media platforms like Facebook, Instagram, WhatsApp to reach out to students. At the end of the survey, we managed to collect around 510 responses from 36 different colleges of 25 different subject streams. The data was collected via a questionnaire based on the Likert Scale for our variable of interest i.e. the overall satisfaction (0 to 4)[6] of online teaching based on their experience so far. We divided other variables into three categories e.g. general factors, technological factors and household level factors which may potentially affect student's overall satisfaction with online teaching.

2.2. Methodology & Variables

Since our dependent variable i.e. overall satisfaction of online teaching is ordered in nature, thus, we used the ordered probit model to estimate the following equation:

$$(\text{Overall Satisfaction})_{ijk} = \alpha + \sum_1^m \beta_m (G_m)_{ijk} + \sum_1^n \gamma_n (T_n)_{ijk} + \sum_1^p \delta_p (H_p)_{ijk} + \theta_j + \psi_k + \varepsilon_{ijk}$$

Where IJK represents the Ith individual from J^{th} subject Stream of Kth College. G_m is the set of general variables (*Teachers ability to take online class (reported by students), availability of reading materials, previous year CGPA and percentage of online attendance*); T_n is the set of technological variables (*network speed, condition of the device, no. of years of using social media, time spent on internet every day, Network Type (mobile/wifi), the device used to attend online class, no. of IOT device at home, no. of social media account, having a laptop or desktop*) and H_p is the set of household-level variables (*availability of separate study room at home, no. of household member during the time of online class, category,*

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[5] Study 3 years under-graduate courses.
[6] 0-fully dissatisfied, 1-somewhat dissatisfied, 2-neutral, 3-somewhat satisfied, 4-fully satisfied.

religion, income and gender of the student). θ_j, ψ_k and ϵ_{ijk} represent subject specific fixed effects, college specific fixed effects and error term respectively. Variables like teacher's ability to take an online class (reported by students)[7], availability of reading materials, previous year CGPA and percentage of online attendance, network speed, years of using social media, time spent on internet every day, no. of IOT device at home, no. of social media account, no. of household member present during the time of online class and income are continuous. Whereas, variables like the condition of the device, network type (mobile/wifi), having a laptop or desktop, availability of separate study room at home category, religion and gender of the student are introduced to our model as dummy variables.

3. Discussion and Results

3.1. Descriptive statistics:

At the end of our survey, we received 510 responses. After cleaning the data, our final count was 482. Out of 482 responses, 26.97% percent of students were fully dissatisfied with online teaching; 25.53% of students were somewhat dissatisfied; 13.28% of students were neutral; 21.16% of students were somewhat satisfied and 13.07% students were fully satisfied with online teaching.

The ultimate aim of the study was to explore all those factors which are responsible for the overall satisfaction of the students from online teaching. Before going into the regression analysis, we wanted to deep dive into the descriptive statistics to explore the probable association between student's overall satisfaction from online teaching and responsible factors. Column "a" of Table 1 suggests that teacher's ability to take online classes plays a crucial role in this regard. It shows that student's satisfaction level increases as teacher's ability to take online classes increases as the estimated value increases from fully dissatisfied to fully satisfied. As far as the availability of the reading material is concerned, we observe a similar trend (see column b of table 1). Students who are fully dis-satisfied or somewhat dissatisfied reported very less or inadequate availability of reading materials.

It's a well-known fact that high-speed internet is the backbone of online teaching. Table 1 reinforces this fact. Column c of Table 1 shows that students who are somewhat satisfied or fully satisfied had higher internet speed on average. Along with the internet speed, factors like the condition of the device and years of using social media determine the overall satisfaction of online teaching. Column d of table 1 suggests that 78% of fully dissatisfied students are having some kind of problem (e.g. broken screen of mobile/laptop/tablet, audio-problem or some others) with their device where they used to attend an online class. This number sharply decreases, as student's satisfaction level increases. Only 17% of fully satisfied

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[7] We asked the students to rate the teacher's calibre to teach the subject in a 0 to 4 scale (from fully dissatisfied (0) to fully satisfied (4)). We collected the same information for the 4 different subjects taught a semester. From here, we constructed the average teacher's calibre by taking a simple average. Since the data was collected on a Likert scale and constructing a continuous variable from there by taking the average is not logically correct. However, to check the internal consistency between these 4 variables, we estimated the value of coefficient alpha which is 0.89. This suggests that there is a high internal consistency between the variables. Thus, the variables teacher's calibre to take the online class was introduced in our model as a continuous variable. We did a similar treatment with the availability of reading materials.

students reported some kind of problem with their devices. On the other hand, those who have been using social media for a longer period reported a higher level of overall satisfaction with online teaching. A fully satisfied student on average using social media for around 4.79 years, whereas, a fully dissatisfied student has experience of only 3.24 years on average.

Table 1: Average score of different factors across five different satisfaction levels

satisfaction	General Factors		Technical Factors			Household Factors	
	Teacher's Ability	Availability of Reading Materials	Download Speed	Condition of Device	Years of using social Media	Availability of Separate Study Room	No. of the Household member during class
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Fully Dissatisfied	1.05	0.58	10.45	0.78	3.24	0.17	4.58
Somewhat Dissatisfied	2.04	1.40	17.26	0.67	3.85	0.24	4.28
Neutral	2.58	2.26	15.17	0.44	4.45	0.30	3.42
Somewhat Satisfied	3.12	2.61	18.74	0.49	4.31	0.37	4.00
Fully Satisfied	3.72	3.59	20.31	0.17	4.79	0.56	3.54

Note: Columns a & b report the average teacher's calibre to teach online class & availability of reading materials respectively (the scale ranges from 0 to 4, the higher the better) reported by students. Column c represents the average download speed in Mbps. Column d shows the proportion of damaged devices in each category. Column e represents the averages years of using social media in each category. Column f represents the proportion of availability of separate study rooms in each category. Column g reports the average number of household members present at home during an online class.

Since students are attending online classes from their home, therefore, some household level factors may affect their level of satisfaction. Column e of Table 1 explores that students who have a separate study room at home, tend to be more satisfied. 56% of fully satisfied students have separate study rooms at home vis-à-vis only 17% of fully dissatisfied students. On the contrary, the presence of more members at home during the time of class may negatively affect the concentration level of the students and hence the level of overall satisfaction may deteriorate. The final column of Table 1 indicates that student's satisfaction level increases as the number of household members decrease during the time of attending the online class. On average there were only 3.54 members at the home of fully satisfied students during the time of online class whereas the same is 4.58 for fully dissatisfied students.

This brief analysis gives us the prior belief that these above mentioned factors may play a crucial role in determining the overall satisfaction from an online class.

3.2. Regression Results and Discussion

Partial regression results are presented in Table 2 (for full model specification, please see appendix). We have shown five model specifications of ordered probit estimation. Model 5 is the most stringent specification which includes all the general variables, technological variables, household-level variables, college fixed effect and subject fixed effect. We have reported only the statistically significant factors which affect overall satisfaction from online teaching. We have also reported the marginal effect (see table 3) of our most stringent specification which is model 5 from table 2.

In the previous section, we have discussed that teacher's ability to take the online class may affect the overall satisfaction of the students. Our regression analysis reinforces that fact. Teacher's ability to take online

classes significantly affects the student's satisfaction level. Teachers with poor ability to take the online class may fail to motivate students or draw attention. Model 5 of Table 2 shows that as the teacher's ability to take online classes increases, students are likely to be satisfied. Since we have collected the data of teacher's ability on a Likert scale for four different subjects and constructed a continuous variable to estimate the effect of it on student's satisfaction. Therefore, the magnitude of this estimates is meaningless, however, the sign and significance level is very important. Similarly, the subsequent estimates of marginal effect are redundant[8].

Table 2: Regression Analysis

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5
General Variables					
Teacher's Ability to take Online Class	**0.446***	**0.424***	**0.422***	**0.447***	**0.422***
	(0.065)	**(0.066)**	**(0.065)**	**(0.069)**	**(0.067)**
Availability of Reading Materials	**0.547***	**0.538***	**0.544***	**0.563***	**0.669***
	(0.068)	**(0.066)**	**(0.065)**	**(0.069)**	**(0.075)**
Technical Variables					
Download Speed		**0.006**	**0.005**	**0.006***	**0.007**
		(0.003)	**(0.003)**	**(0.003)**	**(0.003)**
Condition of Device (Having Problem=1)		**-0.404***	**-0.371***	**-0.323**	**-0.287**
		(0.112)	**(0.115)**	**(0.127)**	**(0.137)**
No. of years of using social media		**0.056***	**0.055***	**0.061***	**0.069***
		(0.029)	**(0.030)**	**(0.033)**	**(0.036)**
Avg. Time spend on internet everyday		-0.008	-0.013	-0.027	**-0.052***
		(0.026)	(0.026)	(0.027)	**(0.031)**
Household Level Variables					
Availability of Separate Study Room			**0.275**	**0.237***	**0.263***
			(0.128)	**(0.139)**	**(0.158)**
No of Household Member during online class			**-0.049**	**-0.064**	**-0.068**
			(0.024)	**(0.025)**	**(0.029)**
Sex (Female=1)			**0.206***	**0.243***	0.217
			(0.117)	**(0.129)**	(0.166)
Observations	482	481	481	481	481
Course Fixed Effect	No	No	No	Yes	Yes
College Fixed Effect	No	No	No	No	Yes
Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)					

Although these findings are very intuitive, it has a crucial role to play in policy making. Since students are attending the class from their respective homes and there is no peer interaction in person during or after the class, therefore, teacher's ability plays an important role in drawing attention and hence keeps them motivated throughout the class. In the present context of a virtual mode of education adopted hurriedly by educational institutions, many teachers were either not well equipped or struggled to handle the existing technology efficiently. Therefore, it becomes important that teachers are well equipped and efficiently trained to utilise the technologies for the smooth running of the online classes. Amidst widespread uncertainty about the reopening of universities and colleges, it seems the virtual mode of teaching will continue in the near future as the nature of the Corona Virus is not yet completely known to the researchers. Also University Grant Commission (UGC) of India, recently proposed a hybrid mode of teaching in the

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[8] We have reported the marginal effect of a teacher's ability to teach in an online class in table 3, in case anyone is interested. We are also interested in interaction effect, but we did not find any significant impact of any of the interaction term. Tables are available on reasonable request.

future. Therefore, teachers should be well equipped and learn the efficient use of technology for the smooth running of online classes. It emerges out from this analysis that colleges and universities should regularly organize training programs for teachers and keep them updated with the upcoming technologies in the virtual platform so that no students suffer.

Table 3: Marginal Effect of Model 5 in Table 2

| VARIABLES	Fully Dissatisfied	Somewhat Dissatisfied	Neutral	Somewhat Satisfied	Fully Satisfied
Education Related Variable					
Teachers Ability to Take Online Class	-0.086***	-0.075***	0.056***	0.094***	0.011***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Availability of Reading Materials	-0.137***	-0.119***	0.089***	0.149***	0.018***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Technical Variables					
Download Speed	-0.001*	-0.001*	0.001*	0.001*	0.001*
	(0.058)	(0.055)	(0.056)	(0.055)	(0.071)
Condition of Device (Having Problem=1)	0.058**	0.052**	-0.037**	-0.064*	-0.008*
	(0.036)	(0.049)	(0.036)	(0.055)	(0.090)
No. of years of using social media	-0.014*	-0.012	0.009*	0.015*	0.002*
	(0.061)	(0.069)	(0.066)	(0.061)	(0.090)
Time spend on internet per day	0.010	0.009	-.007	-0.011*	-0.001
	(0.101)	(0.108)	(0.112)	(0.098)	(0.118)
Household Level Variables					
Availability of Separate Study Room	-0.051*	-0.051	0.031*	0.061	0.008
	(0.084)	(0.124)	(0.077)	(0.111)	(0.174)
No of Household Member during online class	0.014**	0.012**	-0.009**	-0.015**	-0.002**
	(0.021)	(0.029)	(0.027)	(0.022)	(0.040)
Sex (Female=1)	0.045	-0.038	0.029	0.048	0.006
	(0.200)	(0.185)	(0.202)	(0.186)	(0.206)
Observations	482	481	481	481	481
Course Fixed Effect	No	No	No	Yes	Yes
College Fixed Effect	No	No	No	No	Yes
Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)					

Note: Some of the standard error reported here looks 0.000, because these reported till three decimal points.

Another important ingredient of online teaching is the availability of study material. As students are attending classes from home and access to resources like a library, reference books, and notes is very limited. This study finds that the availability of reading/study material significantly affects the overall satisfaction level. Model 5 of Table 2 shows that the availability of reading materials is significantly and positively associated with satisfaction level. In this case, also, the magnitudes of the estimates and subsequent marginal effect of availability of reading materials are meaningless because of similar logic mentioned in the previous paragraph, however, sign and significance level has an important role in policy making. When universities and colleges are continuing their teaching online or will be continuing online in near future and universities are getting ready to embrace the hybrid mode of teaching even after the post-pandemic period as per new UGC guidelines, timely availability of reading materials is of paramount importance, especially in absence of in-person interaction with teachers and peers. In this situation, students rely heavily on the electronic reading materials made available to them. It seems due to an abrupt shift to the online mode of teaching there was a lack of adequate and relevant e- materials for the courses. Therefore, when colleges and universities are getting ready to take their teaching online during the time of pandemic or even in the post-pandemic period, properly planned reading materials should be made available to the students at every stage of the course, so that no students feel alienated or feel dissatisfied.

Further, as we have already discussed in the previous section that technological factors e.g. high-speed internet, individual exposure to technology are the backbone of successful online teaching. The same has come out of our analyses suggesting that high-speed internet facilities improve the overall satisfaction level of students (see table 2 and table 3 (marginal effect)). The solid line in the top left of figure 1 shows that the probability of being fully dissatisfied is close to 30% when network speed is less than 1Mbps, but it goes down to below 20% if download speed is close 100Mbps. Conversely, the bottom left line of figure 1 shows that the probability of being highly satisfied is close to 10% if the download speed is less than 1Mbps, but it improves to greater than 20% if the download speed is close to 100Mbps. Though broadband (wireless (4G network), wired connection) consumers in India is increasing at a rapid pace, it is concentrated mainly in urban and suburban areas and penetration of high-speed network in rural areas are not increasing at a similar rate. At present 4G network is the dominant broadband service provider in India, but its coverage is not uniform across all parts of India. Therefore, the students who are attending classes from remote areas, are facing difficulties to take full advantage of online teaching. Therefore, many students may be left out from the equal access to learning. Though this factor is exogenous to universities and colleges as they do not have any control over it, but they can adopt such technologies which can provide a better experience with low bandwidth and also provide such reading materials which can be easily downloaded or watched even in low bandwidth situation.

In a nutshell, efficient coordination between administrative staff, teachers and IT professionals can make this possible where teachers are trained regularly and informed about the upcoming technologies; properly planned reading materials are provided timely and of course, creating user-friendly materials which can be easily downloaded or watched even in the low bandwidth situation.
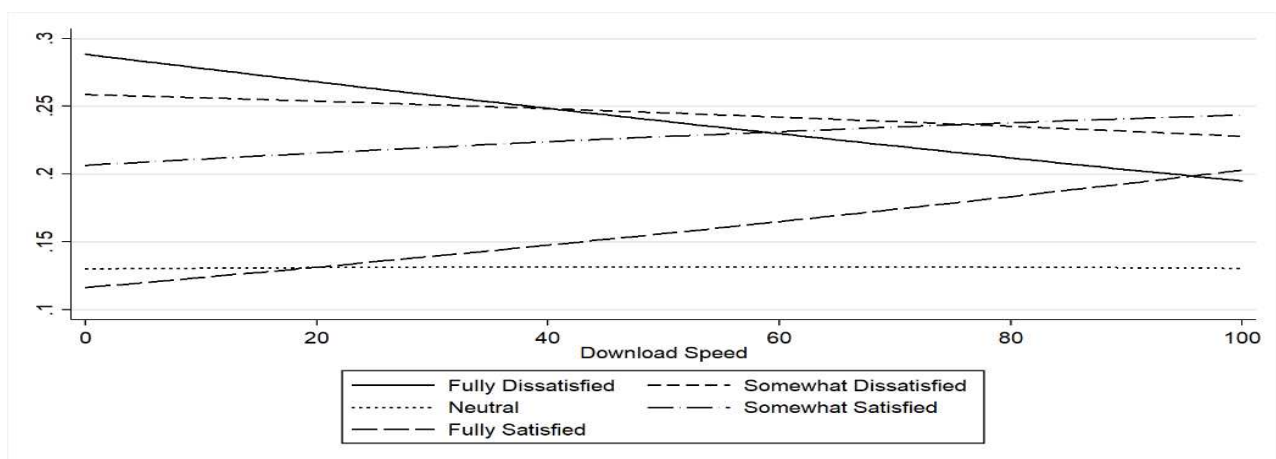
Figure 1: Marginal Effect of download speed

This analysis also identifies that if there are some issues (screen broken, audio/video problem, any others) with the device, then it negatively affects the overall satisfaction of online teaching (see Table 2 and 3). Table 3 shows that problematic devices are associated with 5.8% likely to be fully dissatisfied; 5.2% likely to be

somewhat dissatisfied; 3.7% less likely to be neutral; 6.4% less likely to be somewhat dissatisfied and 0.8% less likely to be fully satisfied. Since damaged devices negatively affect the overall satisfaction of online teaching, therefore, to get the full benefit out of online teaching, damaged devices should be repaired or replaced on time. But, replacing devices for students from poorer backgrounds could be financially troublesome. In this situation, colleges or universities can help students by lending devices e.g. laptops, tablets to get the full advantage of online teaching. Many colleges and universities of the developed nations have the policy of *borrowing laptops/tablets* for quite a long time. However, implementation of lending policy is not very easy in a very quick manner, but once it is operational, it might be of great help to the students when the future belongs to the hybrid mode of teaching.

We have also noticed that those who have been using social media for a longer period, tend to have greater overall satisfaction from online teaching. Table 3 shows that one year increase in using social media is associated with 1.4% and 1.2% less likely to be fully dissatisfied and somewhat dissatisfied respectively. Conversely, one year increase in using social media is associated with 0.9%, 1.5% and 0.2% likely to be neutral, somewhat satisfied and fully satisfied respectively. This could be because for those who have been using social media for a longer time, their *social capital* is relatively higher. Therefore, these students are better connected with their peers and have better information about online resources which facilitate their experiences of online teaching. Universities and colleges can facilitate online teaching by providing a virtual platform[9] e.g. *Google jamboard, Piazza, etc.* as a substitute for in-person interaction, where, students can express their views, interact with other students, clear their doubts, etc. This will also help students to build up social capital. Many universities and colleges have already started using these virtual platforms where students can interact whenever they want, but it is far from required.

We have also observed that students spending more time on the internet per day are negatively affected. Though the effect is not highly statistically significant. More time on the internet, may divert the attention of students from actual study and hence breaks the concentration during the time of class.

This study also identifies some household-level factors which affect the overall satisfaction of online teaching. We find that the availability of separate study rooms improves the overall satisfaction. Table 3 suggests that having a separate study room is associated with 5.1% less likely to be dissatisfied. Availability of a separate study room can help the student to concentrate on online class uninterruptedly and hence increase the overall satisfaction of online teaching. We also notice that as the number of household members increases at home during the time of class, the overall satisfaction level decreases. Our results suggest that a rise in one family member during the time of class at home is associated 1.4% more likely to be fully dissatisfied, 1.9% more likely to be somewhat dissatisfied, 0.9% less likely to be neutral, 1.5% less likely to be somewhat satisfied and 0.2% less likely to be highly satisfied. The reason is very intuitive. As the number

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[9] Some of the virtual platforms are available free of cost, however, proper management is required to maintain the smooth running of these platforms.

of households member increases at home during the time of class, it creates noise and disturbance and hence breaks the concentration of the students.

In summary, our analysis using online survey data suggests that teacher's ability to take online classes and availability of electronic reading materials play a pivotal role in improving the overall satisfaction of students from online teaching. Teachers with poor ability to conduct online classes fail to motivate students whereas adequate availability of reading materials increases the overall satisfaction of online teaching. Our analysis also suggests that higher internet speed and more number of years in social media are associated with a higher level of overall satisfaction. Conversely, damaged devices and more time on the internet per day may reduce the satisfaction level. Students who have separate study rooms experience a greater level of overall satisfaction. On the contrary, a more number of family members at home during the time of online class negatively affects the overall satisfaction of online teaching.

4. Conclusion

2nd wave of coronavirus pandemic has devastated all parts of India. Economic activities stood still. Academic institutions were shut down with no sign of reopening anytime soon. After economic activities, education was the 2nd most affected sector during these times. World Bank estimated a loss of 400 billion dollars of countries' future earnings due to the prolonged closure of academic institutions. In this situation to keep the academic activities running, most of the universities and colleges have shifted their teaching to virtual platforms like Google meet, zoom, Microsoft team, WhatsApp, etc. Online teaching was adopted by most universities and colleges. All these were done in a hurry and compulsion without any prior experiences. Unpreparedness was visible at every stage. Teachers and students both have been facing continuous challenges while adopting and handling this new mode of teaching.

While the country is bracing itself to cope up with the 3rd wave of the pandemic, educational institutions are in the doldrums about reopening and we don't know when the traditional mode of teaching will be resumed. Hence, online teaching is going to continue in the near future. Recently, University Grant Commission (UGC) of India passed an order which allows colleges and universities to continue their class in hybrid mode (partial online (up to 40%) and rest is the traditional mode of teaching) during normal times. Therefore, to continue with online teaching or hybrid mode of teaching, colleges and universities need a proper plan of action for successful implementation where student's academic losses are mitigated.

This analysis provides us some important insights into the scope and feasibility of online teaching in India. These findings will help us to develop a policy for online teaching in the future. We show that teacher's ability to take online classes and availability of reading materials are the most important component of successful implementation of online teaching along with some important technical and household level factors. This study suggests that the poor ability to take an online class of a teacher may reduce the overall satisfaction of online teaching for students. On the contrary, timely availability of relevant reading materials improves the overall experience of online teaching of students. Therefore, we propose, universities and

colleges should organize regular training sessions for teachers to keep them updated about the challenges and possible ways out of online teaching for successful implementation of this model. As students are at the receiving end of the online mode of teaching and have very little scope to express themselves, in this situation poor quality teaching may further aggravate the academic gain. Similarly, the academic institutions should have a proper plan to prepare the course content and references. For example soft copies of books, audio/video lectures, notes, etc. which could be made available timely at every stage of the teaching.

We also find that high-speed internet improves the overall experience which is very intuitive. But those who are attending a lecture from a remote place where high-speed internet is not available may face trouble in attending the online class. Therefore, we propose, university and college administration should work together with respective subject teachers and IT profession to create user-friendly course content which can be easily downloaded/watched even with the low internet speed. We have also shown that damaged devices can lower the overall experience of online teaching. However, lending facilities of devices like laptops/tablets for attending online classes by the universities and colleges for those who cannot afford to buy a new device in case of damages can overcome this. Though the borrowing concept is not widely adopted by universities and colleges in India, the implementation of such policies in this current scenario will improve the overall experience of students. We also find that students who have a higher level of social capital tend to have a better experience of online teaching. At present students gets hardly any chance to interact with other students and teachers, therefore, their social capital is low as compared to those who are connected through greater social network for a longer time. In this regard, we propose, universities and colleges should provide a virtual platform, where students can interact with each other and increase their social capital.

All this will come at a cost of harmonized efforts from all the stakeholders. Thus, a coordinated effort from administration, teachers and IT professionals can make this possible. Initially, there could be some hardship, but once it is ready, students will be the greatest beneficiaries.

When universities and colleges are getting ready with visible unpreparedness to continue the teaching in online mode or to adopt the hybrid mode of teaching, this analysis put some light on the importance of formulating some meaningful policies regarding online teaching in Indian universities. Our study opens up the question of the feasibility of a hybrid mode of teaching in the post-pandemic era in a country like India where many technological barriers are yet achieved.

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Appendix:

Table A1: Full Model Specifications

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5
Education Related Variable					
Teachers Ability to take Online Class	**0.446***	**0.424***	**0.422***	**0.447***	**0.422***
	(0.065)	**(0.066)**	**(0.065)**	**(0.069)**	**(0.067)**
Availability of Reading Materials	**0.547***	**0.538***	**0.544***	**0.563***	**0.669***
	(0.068)	**(0.066)**	**(0.065)**	**(0.069)**	**(0.075)**
Previous CGPA	-0.055	-0.057	-0.056	-0.055	-0.083
	(0.052)	(0.052)	(0.054)	(0.059)	(0.067)
% of Online Attendance	0.050	0.073**	0.055	0.053	0.066
	(0.035)	(0.035)	(0.035)	(0.036)	(0.041)
Technical Variables					
Download Speed		**0.006***	**0.005***	**0.006***	**0.007***
		(0.003)	**(0.003)**	**(0.003)**	**(0.003)**
Condition of Device (Having Problem=1)		**-0.404***	**-0.371***	**-0.323***	**-0.287***
		(0.112)	**(0.115)**	**(0.127)**	**(0.137)**
No. of years of using social media		**0.056***	**0.055***	**0.061***	**0.069***
		(0.029)	**(0.030)**	**(0.033)**	**(0.036)**
Avg. Time spend on internet everyday		-0.008	-0.013	-0.027	**-0.052***
		(0.026)	(0.026)	(0.027)	**(0.031)**
Network Type (Wi-Fi=1)		-0.212*	-0.231*	-0.186	0.003
		(0.123)	(0.127)	(0.134)	(0.156)
Device for Online Class					
Desktop/Laptop		Base	Base	Base	Base
Mobile/Tablet		0.248	0.243	0.326	0.335
		(0.236)	(0.235)	(0.254)	(0.259)
Mobile/Tablet/Desktop/Laptop		0.086	0.060	0.121	0.101
		(0.226)	(0.224)	(0.238)	(0.264)
No of active IOT Device at home		0.004	0.006	0.011	-0.001
		(0.021)	(0.021)	(0.022)	(0.026)
No of Social Media Accounts		0.021	0.015	0.022	0.008
		(0.058)	(0.056)	(0.060)	(0.069)
Having a Laptop/Desktop		0.128	0.062	0.079	0.163
		(0.135)	(0.137)	(0.144)	(0.150)
Household Level Variables					
Availability of Separate Study Room			**0.275***	**0.237***	**0.263***
			(0.128)	**(0.139)**	**(0.158)**
No of Household Member during online class			**-0.049***	**-0.064***	**-0.068***
			(0.024)	**(0.025)**	**(0.029)**
Sex (Female=1)			**0.206***	**0.243***	0.217
			(0.117)	**(0.129)**	(0.166)
Religion (Hindu=1)			0.185	0.166	0.073
			(0.137)	(0.148)	(0.180)
Category (Unreserved=1)			-0.131	-0.201	-0.226
			(0.120)	(0.129)	(0.151)
Family Income (Yearly)			0.013	0.032	0.051
			(0.038)	(0.040)	(0.045)
Constant cut1	1.044***	1.346***	1.240***	1.216**	0.678
	(0.264)	(0.395)	(0.449)	(0.565)	(0.958)
Constant cut2	2.187***	2.537***	2.453***	2.492***	2.110**
	(0.270)	(0.395)	(0.455)	(0.568)	(0.956)
Constant cut3	2.772***	3.144***	3.070***	3.138***	2.797***
	(0.274)	(0.394)	(0.456)	(0.568)	(0.953)
Constant cut4	3.940***	4.371***	4.326***	4.421***	4.159***
	(0.291)	(0.404)	(0.466)	(0.580)	(0.954)
Observations	482	481	481	481	481
Course Fixed Effect	No	No	No	Yes	Yes
College Fixed Effect	No	No	No	No	Yes
Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)					