Research Article

Effectiveness and Efficacy of Online Undergraduate and Post-Graduate Courses in India: A Pre-emptive Analysis

G.K. Chetan Kumar[1], Rangappa K.B.[2] & Suchitra S[3]

[1]Assistant Professor, Head of Economics Dept , Government First Grade Degree College Siddapur, Sirsi

Email: chetankumar.dragonlordv7@gmail.com

[2]Professor, Department of Studies in Economics, Davangere University, Davangere, Karnataka

[3]Professor, Department of Studies in Economics, Davangere University, Davangere, Karnataka

Abstract

The Indian education system is in a state of transition. National Education Policy 2020 of India has envisaged leveraging technology to enhance the reach and efficacy of education. In line with the same, in 2023, University Grants Commission (UGC) of India, which is the apex institution for governing higher education, has given permission for 57 Indian Universities to commence online graduate and postgraduate courses. Karnataka has become the first state in India to actively implement a National Education Policy and leverage technology to enhance the learning experience. In this regard, the study aims to identify and analyze the factors which influence the effectiveness of technology in improving learning outcomes among graduate and postgraduate students in Karnataka.

Keywords: National Education Policy 2020, UGC, Online Education, Graduate Students, Postgraduate Students

Introduction

Indian Education System is in a much-needed phase of transition. This transition needs to address both the quality and quantity concerns of the Indian Education System. When it comes to quality issues, according to a recent report of Times Higher Education (THE) Rankings (2023 Edition), among the top 500 Universities in the world, India shares only 5 Universities, the best being the Indian Institute of Science, which was in 251-300 band. Furthermore, according to Quacquarelli Symonds (QS) World University Rankings (2023 Edition), none of the Indian Universities were able to feature in the top 150. In the top 500, only 9 Universities have managed to make a place for themselves, again, the best being the Indian Institute of Science, which had secured 155th rank. These metrics reflect that, on the quality front, Indian Universities have a great deal of scope for improvement.

According to the recent Indian Census, which was conducted in 2011, only 8.15 per cent of the Indian populace were graduates, and 4.15 per cent of the Indian populace were postgraduates. So, even when it comes to quantity, India has a long way to go to address the educational needs and requirements of its populace. This is all the more important because India is in the phase of encashing its demographic dividend. 62.5 per cent of the Indian population are in the age group of 15-59 years. According to the Economic Survey 2018-19, the demographic dividend of India is expected to peak by around 2041, when the share of the Indian working-age population (20-59) is expected to be around 59 per cent.

If proper measures are not undertaken in time to train the burgeoning young populace of India, then India's demographic dividend might as well become a demographic liability for the nation. Understanding and acknowledging the crucial importance of education for Indian youth, the Central government of India brought about the National Education Policy in 2020, with an aim to address the quality and quantity concerns of the Indian educational System and to make necessary structural, administrative and organisational changes. In fact, National Education Policy 2020 has stressed a great deal about the possibilities of leveraging technology to address the quantity and quality concerns of the Indian Education System.

In line with the same, in January 2023, University Grants Commission (UGC) of India, which is the apex body for governing higher education, gave permission for 57 Indian Universities to run online graduate and postgraduate courses in India. Among Indian states, Karnataka has become the first state to implement National Education Policy 2020. Before full-fledged online classes are started, we wanted to estimate and identify the various factors which may impact the efficacy of online learning among graduate and postgraduate students in the state of Karnataka. Hence, the present study was undertaken.

Literature Review

According to Goundar and Bimal (2022), most of the studies pertaining to online learning in recent times have been set in developed countries of Asia and Europe. So, there is a need to understand the feasibility of online learning in a developing country like India. To identify the relevant variables which needed to be considered for our study, we tried to understand the various variables which were taken for consideration by previous researchers who had worked to analyze the efficacy of online learning among students pursuing higher education. Based on the review of the literature, the prominent variables which we were able to identify were as follows:

Gender: Based on previous literature, we observed that the role of gender in determining the usefulness of technology among students is a bit vague. Some empirical studies (Upadhayaya et al., 2021; Sitala Khan et al., 2023;) pertaining to online learning among undergraduate students noted that gender did not have any statistically significant association with the usefulness of technology. Furthermore, studies (Paris, 2004; Singh,2021) conducted among senior secondary students also did not observe any statistically significant association between gender and the usefulness of technology in enhancing their learning outcomes.

However, some other empirical studies (Singh & Riza, 2022) did find gender to play a statistically significant role in how undergraduate students perceived the usefulness of technology in enhancing their learning outcomes.

Nature of residence: One of the other variables affecting the usefulness of technology is the nature of residence. Kumar et al. (2022), in their study, which focused on analyzing the effectiveness of ICT among rural and urban graduate students pursuing higher education in India, found that urban graduate students were more adept in leveraging technology to enhance their learning outcomes as opposed to rural students. Another study conducted by Upadhayaya et al. (2021) among undergraduate students of Nepal also came to the conclusion that the nature of residence had a prominent impact on the graduate student's perception of the usefulness

of technology. Furthermore, another study undertaken by Surapuramath, (2021) during COVID time also asserted the role of place in affecting the usefulness of technology among students. Even in a much more recent study, which was undertaken during the post-pandemic period by Papadaki et al. (2023), the researchers have noted that environmental and cultural aspects had a significant influence on the usefulness of technology.

Gadgets: From the available literature we were not able to derive any conclusive view as to which of the digital tools were more effective in enhancing learning outcomes. Ullah and Khan (2017), in their empirical research, observed that personal computers did not have any significant association with enhancing the learning outcomes of students pursuing higher education. However, another study undertaken by Cross et al (2019) pertaining to e-learning among graduate students observed a positive correlation between handheld digital devices and improvement in their learning efficacy. In another empirical study undertaken by Kumar & Rangappa (2021), the researchers observed that smartphones were more useful in enhancing the learning outcomes of rural students and tablets were more useful in enhancing the learning outcomes of urban students.

Applications: With regards to evaluating the efficacy of applications in enhancing learning outcomes, through our literature review, we couldn't find any negative association. So (2016) conducted a controlled group study among undergraduate students who had enrolled in a Teacher's training institute in Hong Kong. Through his empirical study, he inferred that the group which used WhatsApp exclusively for study purposes fared much better than the group which had used WhatsApp for generic purposes. Sözen & Guven (2019) conducted a study among undergraduate geography students, and they observed that online tools for assessment were viewed favourably by the study group. Further, Rajan (2021), through his research, inferred that a mobile learning application termed "Mel app" enhanced the efficacy of learning outcomes among e-learners.

Educational Stream: From our review of previous studies, we were able to note that even the stream of students in question played a significant role in determining their efficacy with technology. Bhuvaneswari, A. S. & Padmanaban, T. (2012), through their study, observed that there was a definite difference in the attitude of arts and science students with regard to the usefulness of technology in learning. Vajravelu and Tammy (2016), through their empirical study, inferred that ICT enhanced the learning outcomes of students studying Calculus. Another study conducted by Kumar et al. (2022) in rural India observed that, among graduate and post-graduate students pursuing Arts, Science and Commerce, students pursuing Science were more adept in using ICT to enhance their learning outcomes as opposed to students pursuing Commerce or Arts. Further, another recent study conducted by Sitala Khan et al. (2023) also observed that there was a significant difference in the attitude between the undergraduate students of Arts and Science with regard to the perception of the usefulness of technology in enhancing their learning outcomes.

Infrastructure: From our review of previous studies, we were able to infer that ICT infrastructure played a prominent role in enabling students to effectively use technology. For instance, Katyetova (2023), in her study in Kazakhisthan observed that ineffective ICT infrastructure in Kazakhistan reduced the efficacy of online learning outcomes among students. Furthermore, other studies (Keskin et

al.,2022; Bawaneh & Malkawı.,2023) have also asserted the importance of infrastructure in facilitating e-learning.

Educational Level: Another prominent variable which seems to influence e-learning outcome of students is the students' educational level. Keskin et al. (2023) in their study observed that undergraduate students were not satisfied with online learning. On the other hand, Omar et al. (2021) in their study observed that undergraduate students were satisfied with online learning.

Demographic Factors: Shia et al. (2006) and Upadhyaya et al. (2021) in their respective studies pertaining to online learning, observed that demographic features like school type, ethnicity and the like did not play any significant role with regards to students' perception of online learning.

Community Based Learning: Physical isolation of students from other students is one of the problems with online learning platforms. Studies which have reflected on this issue have observed that structured discussion (Tibi, 2018) among teachers and students along with moderated discussion among students (Tibi, 2018; Rehman et al., 2023) helps in enhancing their e-learning outcomes.

In our research design, we have made an effort to inculcate most of the prominent variables observed in previous studies.

Research Desıgn & Methodology

There are several studies which have tried to evaluate the efficacy of online learning at global level and in India. Global studies (Lederman, 2020; Swan et al., 2020; Voloshinov, 2020; Opara, 2023) pertaining to online learning have substantiated that online learning does have the potential to enhance the learning outcome of students.

Even in the context of India, there are several studies (Kumar & Rangappa 2021; Kumar et al., 2022; Sitala et al., 2023; Khan et al., 2023) which have made an attempt to evaluate the efficacy of online learning. Some of the studies (Thakkar & Joshi, 2017) have supported online education's potential to supplement offline learning whereas some studies (Namreen & Panakaje, 2022) have observed the absence of proper ICT infrastructure in India to facilitate full-fledged online learning. India is a land of extremes; what is true in the context of India can be equally untrue. Particularly in the backdrop of our research premise, one needs to note that:

National Education Policy (2020) was envisaged to leverage technology to enhance the learning outcomes of students across India. In this backdrop University Grants Commission has given permission for 57 Universities to run full-fledged online graduate and postgraduate courses in India. Full-fledged online learning is a recent phenomenon in India whose waters are yet to be tested. There is scarcity of research pertaining to efficacy of full-fledged online learning in India. As Karnataka became the first state in India to implement NEP, we conducted our research in Karnataka.

We have undertaken our study to aid the government and educational institutions in drawing a better framework for designing and implementing online graduate and postgraduate courses. The preliminary objectives behind our undertaken research are as follows:

1. To identify the socio-economic and technological factors which are affecting the usefulness of technology among students.
2. To assess as to which educational stream is more favorable for implementing full-fledged online learning.

3. To assess the efficacy of graduate and postgraduate students across technological parameters pertaining to online learning.
4. To analyze the formulated objectives, the corresponding hypotheses formulated for the undertaken study are as follows:

Hypothesis 1. Both socio-economic factors and technological factors affect the usefulness of technology in enhancing students' learning outcomes.

Hypothesis 2. Online learning may not be equally effective for all educational streams.

Hypothesis 3. The efficacy of Graduate and Postgraduate students is likely going to differ across different technological parameters pertaining to online learning.

Sampling and Data Collection

The set objectives of our study were to identify and analyze the factors which could influence online learning among graduate and post graduate students in the state of Karnataka.

Profile of the Study Area: Karnataka is one of the economically stronger states of India. Despite being the third richest state in terms of State Gross Domestic Product (2023), Karnataka does have glaring intra-regional inequalities. Due to the presence of extreme intra-regional inequalities in its various districts, we can, to some extent, to understand the efficacy of online learning across economically diverse districts based on the incidence of poverty.

Research Methodology: The research methodology for this study focuses on understanding the efficacy of online learning across districts in Karnataka, stratified by poverty incidence, using the 2021 Multidimensional Poverty Index (MPI) from NITI Aayog. The districts selected represent varying levels of poverty: Bangalore and Mysore for the lowest poverty incidence, Davangere and Chitradurga for average poverty incidence, and Yadgir for the highest poverty incidence. Proportional sampling was employed to ensure that the number of respondents reflected the population size of each district according to the 2011 Census. A total of 570 graduate and postgraduate students were surveyed, with 400 respondents from Bangalore and Mysore, 130 from Davangere and Chitradurga, and 40 from Yadgir. The graduate-to-postgraduate ratio was set at 2:1, mirroring national education trends, with 380 undergraduate students and 190 postgraduate students being included in the sample.

Data was collected through questionnaires administered in person by the researcher, ensuring consistency and accuracy in responses. The survey was conducted at various universities and colleges, including Bangalore University, Bangalore City University, Don Bosco Institute of Management, St. Francis College (Bangalore), Government First Grade College (Mysore), Davangere University, and Government First Grade Colleges and Post Graduate Centers in Chitradurga and Yadgir. The questionnaire focused on key aspects of students' experiences with online learning during the COVID-19 pandemic, including access to technology, quality of online content, learning outcomes, and overall satisfaction.

The sampling methodology was designed to ensure a representative sample across districts with different poverty levels. Data analysis involved using of statistical tools to compare factors like accessibility, student engagement, learning outcomes, and satisfaction with online learning across the selected districts. Ethical

considerations were prioritized, with informed consent obtained from all participants, confidentiality maintained through anonymized data, and voluntary participation ensured, allowing respondents the freedom to withdraw from the study at any time. This approach has tried to ensure a comprehensive understanding of the impact of socio-economic disparities on online learning in the state of Karnataka.

Empirical Analysis

First objective

The first objective of our study was to understand the various socio-economic factors which affected the ability of the students to leverage technology to enhance their learning outcomes. From tables 1, 2, 3 and 4 we have made an attempt to understand as to which of the socio-economic and technological factors have their influence on students' ability to leverage technology for enhancing their learning outcomes.

Table-1: Significance of association between socio-economic factors and usefulness of technology

Usefulness of Technology / Socio Economic Factors		Low	Medium	High	Total	Fishers' Exact /χ2 P-Value
Gender	Female	34	145	146	325	χ2 7.34 P-Value: 0.025*
		(50.75)	(63.88)	(52.90)	(57.02)	
	Male	33	82	130	245	
		(49.25)	(36.12)	(47.10)	(42.98)	
	Total	67 (100.00)	227 (100.00)	276 (100.00)	570 (100.00)	
Place	Bangalore Urban	29	80	105	214	Fisher's Exact P-Value: 0.000**
		(43.28)	(35.24)	(38.04)	(37.54)	
	Mysore	24	71	91	186	
		(35.82)	(31.28)	(32.97)	(32.63)	
	Davangere	10	52	29	91	
		(14.93)	(22.91)	(10.51)	(15.96)	
	Chitradurga	01	17	21	39	
		(01.49)	(07.49)	(07.61)	(06.84)	
	Yadgir	03	07	30	40	
		(04.48)	(03.08)	(10.87)	(07.02)	
	Total	67 (100.00)	227 (100.00)	276 (100.00)	570 (100.00)	

Caste	Scheduled Tribe	02	09	05	16	Fisher's Exact P-Value: 0.531
		(02.99)	(03.96)	(01.81)	(02.81)	
	Scheduled Caste	17	40	52	109	
		(25.37)	(17.62)	(18.84)	(19.12)	
	Other Back-ward Caste	34 (50.75)	121 (53.30)	135 (48.91)	280 (50.88)	
	General (Poor)	00	01	02	03	
		(0.00)	(00.44)	(00.72)	(00.53)	
	General	14	56	82	152	
		(20.90)	(24.67)	(29.71)	(26.67)	
	Total	67 (100.00)	227 (100.00)	276 (100.00)	570 (100.00)	
	Absent	19	111	109	239	χ^2 10.26 P-Value: 0.006**
		(28.36)	(48.90)	(39.49)	(41.93)	
	Present	48	116	167	331	
		(71.64)	(51.10)	(60.51)	(58.07)	
	Total	67 (100.00)	227 (100.00)	276 (100.00)	570 (100.00)	

*Note. *p<.05, **p<.01*

From Table 1, we can observe that, among students, nearly 52 per cent of girls found technology to enhance their learning outcomes.

Interestingly, when it came to place, from our research we were able to infer that students who were belonging to districts like Bangalore and Mysore, found technology to be highly effective in enhancing their learning outcomes. This does seem logical as districts of Bangalore and Mysore do have better ICT infrastructure as compared to rest of the districts.

To the readers who are not well versed about the societal dynamics of India, we need to point out that, when it comes to caste categorization, people belonging to the General category are held in high esteem in the social hierarchy, followed by people belonging to the General (Economically Weaker Section), Other Backward Castes, Scheduled Castes and Scheduled Tribes. Through our research, we were able to infer that the caste of the student did not play any statistically significant role in determining the usefulness of technology. Further, through our research, we were able to infer that the students who had a separate room for studying found technology to be highly useful in enhancing their learning outcomes. In Table 2, we have made an attempt to analyze which of the digital devices were more beneficial for the students in leveraging technology to enhance their learning outcomes.

Table-2: Significance of the association between digital gadgets and the usefulness of technology

Usefulness of / Technology Digital Gadgets		Low	Medium	High	Total	Fishers' Exact /χ2 P-Value
Mobile	Not Using	05	06	06	17	χ2 5.36 P-Value: 0.069
		(07.46)	(02.64)	(02.17)	(02.98)	
	Using	62	221	270	553	
		(92.54)	(97.36)	(97.83)	(97.02)	
	Total	67 (100.00)	227 (100.00)	276 (100.00)	570 (100.00)	
Tablet	Not Using	67	225	269	561	Fisher's Exact P-Value: 0.251
		(100.00)	(99.12)	(97.46)	(98.42)	
	Using	00	02	07	09	
		(00.00)	(00.88)	(02.54)	(01.58)	
	Total	67 (100.00)	227 (100.00)	276 (100.00)	570 (100.00)	
Personal Computer	Not Using	65	222	263	550	Fisher's Exact P-Value: 0.316
		(97.01)	(97.80)	(95.29)	(96.49)	
	Using	02	05	13	20	
		(02.99)	(02.20)	(04.71)	(03.51)	
	Total	67 (100.00)	227 (100.00)	276 (100.00)	570 (100.00)	
Laptop	Not Using	57	200	228	485	χ2 2.96 P-Value: 0.227
		(85.07)	(88.11)	(82.61)	(85.09)	
	Using	10	27	48	85	
		(14.93)	(11.89)	(17.39)	(14.91)	
	Total	67 (100.00)	227 (100.00)	276 (100.00)	570 (100.00)	

*Note. *p<.05, **p<.01*

From table 2, we couldn't derive any statistically significant inference between the relationship between digital gadgets and usefulness of technology. In table 3, we have made an attempt to understand as to which of the digital applications normally used by students were more useful for them in leveraging technology to enhance their learning outcomes.

Table-3: Significance of association between digital applications and usefulness of technology

Usefulness of Technology / Digital Applications		Low	Medium	High	Total	Fishers' Exact /χ2 P-Value
YouTube	Not Using	10	17	45	72	χ2 9.13 P-Value: 0.010*
		(14.93)	(07.49)	(16.30)	(12.63)	
	Using	57	210	231	498	
		(85.07)	(92.51)	(83.70)	(87.37)	
	Total	67 (100.00)	227 (100.00)	276 (100.00)	570 (100.00)	
Educational Websites	Not Using	13	27	39	79	χ2 2.47 P-Value: 0.290
		(19.40)	(11.89)	(14.13)	(13.86)	
	Using	54	200	237	491	
		(80.60)	(88.11)	(85.87)	(86.14)	
	Total	67 (100.00)	227 (100.00)	276 (100.00)	570 (100.00)	
Educational Applications	Not Using	40	96	118	254	χ2 7.05 P-Value: 0.029*
		(59.70)	(42.29)	(42.75)	(44.56)	
	Using	27	131	158	316	
		(40.30)	(57.71)	(57.25)	(55.44)	
	Total	67 (100.00)	227 (100.00)	276 (100.00)	570 (100.00)	
Video Applications	Not Using	16	48	68	132	χ2 P-Value: 0.645
		(23.88)	(21.15)	(24.64)	(23.16)	
	Using	51	179	208	438	
		(76.12)	(78.85)	(75.36)	(76.84)	
	Total	67 (100.00)	227 (100.00)	276 (100.00)	570 (100.00)	

*Note. *p<.05, **p<.01*

From Table 3, we can observe that among digital applications, YouTube and Educational websites had a statistically significant relationship with regard to the usefulness of technology among students. Interestingly, Video conferencing apps and educational websites were not found to have any statistically significant impact on enhancing the learning outcomes of students. In Table 4, we have made an attempt to analyze which other technological factors enhanced the impact of technology in enhancing the learning outcome of students.

Table-4: Significance of association between other technological factors and usefulness of technology

Usefulness of Technology / Other Digital Factors		Low	Medium	High	Total	Fishers' Exact /χ2 P-Value
Coverage	Bad	12	33	25	70	χ2 26.62 P-Value: 0.000**
		(17.91)	(14.54)	(09.06)	(12.28)	
	Satisfactory	31	108	89	228	
		(46.27)	(47.58)	(32.25)	(40.00)	
	Good	24	86	162	272	
		(35.82)	(37.89)	(58.70)	(47.72)	
	Total	67 (100.00)	227 (100.00)	276 (100.00)	570 (100.00)	
Access of Electricity	Bad	05	13	10	28	χ2 18.28 P-Value: 0.001**
		(07.46)	(05.73)	(03.62)	(04.91)	
	Satisfactory	24	91	68	183	
		(35.82)	(40.09)	(24.64)	(32.11)	
	Good	38	123	198	359	
		(56.72)	(54.19)	(71.74)	(62.98)	
	Total	67 (100.00)	227 (100.00)	276 (100.00)	570 (100.00)	
Device(s) enhances Learning	No	18	41	12	71	χ2 72.79 P-Value: 0.000**
		(26.87)	(18.06)	(04.35)	(12.46)	
	Maybe	33	101	81	215	
		(49.25)	(44.49)	(29.35)	(37.72)	
	Yes	16	85	183	284	
		(23.88)	(37.44)	(66.30)	(49.82)	
	Total	67 (100.00)	227 (100.00)	276 (100.00)	570 (100.00)	
Ownership of Device	Internet Café	05	00	05	10	Fisher's Exact P-Value: 0.005**
		(07.46)	(0.00)	(01.81)	(01.75)	
	Neighbour	01	01	07	09	
		(01.49)	(00.44)	(02.54)	(01.58)	
	Student's Family	16	63	68	147	
		(23.88)	(27.75)	(24.64)	(25.79)	
	Student	45	163	196	404	
		(67.16)	(71.81)	(71.01)	(70.88)	
	Total	67 (100.00)	227 (100.00)	276 (100.00)	570 (100.00)	

*Note. *p<.05, **p<.01*

From table 4, we can observe that there is a statistically significant relationship between network coverage and availibility of electricity with usefulness of technology among students. Majority of the students who had access to good network facility (58.70 per cent) and had greater access to electricity (71.14 per cent) found technology to be more useful in enhancing their learning endeavour.

Further, from table 4, we can observe that use and ownership of devices also had statistically significant relationship with usefulness of technology among students. 66.30 per cent of students perceived that digital devices enhanced their learning outcomes. 71.01 per cent of students who owned their own digital devices strongly felt that technology enhanced their learning outcomes.

Second objective

Through our second objective, we wanted to analyze as to which educational stream was more conducive to full-fledged online courses in India. Hence, we tested the significance of the association between educational streams and the usefulness of technology through Chi-square. The results are summarized in table 5.

Table-5: Significance of association between educational streams and online learning

Online Learning Educational Stream		Low	Medium	High	Total	Fishers' Exact /χ2 P-Value
Educational Stream	Arts	21	53	88	162	Fisher's Exact P-Value: 0.001**
		(12.96)	(32.72)	(54.32)	(100.00)	
	Commerce	46	139	159	344	
		(13.37)	(40.41)	(46.22)	(100.00)	
	Science	00	35	29	064	
		(00.00)	(54.69)	(45.31)	(100.00)	
	Total	67 (11.75)	227 (39.82)	276 (48.42)	570 (100.00)	

*Note. *p<.05, **p<.01*

From table 5, we can observe that educational stream did have statistically significant relationship with online learning among students. Particularly students belonging to arts stream (54.32 per cent) strongly believed that online learning could enhance their learning outcomes, which was followed by students belonging to Commerce stream (46.22 per cent) and students belonging to Science stream (45.31 per cent).

Third Objective

Through our third objective, we wanted to assess the efficacy of graduate and post-graduate students across various technological parameters pertaining to online learning. To analyze the same, we constructed a binomial logistic regression model. To test the stability and the reliability of the model, we have relied upon the Psuedo R square, the Hosmer-Lemeshow test for goodness of fit and the Proportion by chance criterion. The results of the reliability tests are summarized in subsequent tables.

Table-6: Stability of the model

Binomial Logistic Regression	Total Number of Observations	570
Log Likeihood=-273.27567	LR χ2 (20)	179.07
	Prob>χ2	0.0000**
	Pseudo R^2	0.2468

*Note. *p<.05, **p<.01*

From table 6, we can observe that, the pseudo R square of our model is 0.24. According to Mcfadden (1977, p.35), if the value of Pseudo R square is in the range of 0.2 to 0.4, then the constructed model is supposed to the Pseudo R square are presented in Table 6, we can infer that our model has a ble 6, we can infer that our model has good fit.

Table-7: Case Processing Summary

Case Processing Summary			
Educational Level	Categorical Outcome	Number of Observations	Marginal Percentage
	Under Graduate	380	66
	Post Graduate	190	33
	Total	570	100

The accuracy of the model can be checked by Proportion by chance criterion.

The benchmark accuracy of our model is estimated to be:

1.25 * {(0.66*0.66) + (0.33*0.33)} = 0.694 or 69.4 per cent

Table-8: Estimated accuracy of the Model

Observed Outcome	Predicted		
	Graduate (0)	Postgraduate (1)	Percentage Correct
Graduate (0)	338	42	88.9
Postgraduate (1)	99	91	47.9
Overall Percentage			75.3

From table 8, we can observe that, the estimated accuracy of our model is 75.3 per cent, which is greater than the estimated accuracy of our model i.e., 69.4 per cent. Thus, it implies that the prediction of our model is reliable. The estimation of our binomial logistic regression model is presented in table 9.

From Table 9, we can observe that Students belonging to the science stream are more likely to pursue a master's, followed by students belonging to Commerce and students belonging to Arts. When it comes to gender, girls are more likely to pursue post-graduation as opposed to boys. Among the students who have independent rooms, they

are more likely to be undergraduate students as opposed to postgraduate students. If students use YouTube more frequently to learn, they are more likely to be undergraduate students rather than postgraduate students. On the other hand, if the students are using educational apps and educational websites, they are more likely to be postgraduate students. Furthermore, if students find educational websites more useful, they are more likely to be postgraduate students.

Table-9: Estimation of Binomial Logistic Regression Model (Undergraduate student is taken as base reference category)

Education Level (Base Undergraduate Students)	Coeffecient	Std. Err.	z	p>|z|
Education Stream Coded	1.020651	0.1971537	5.18	0.000**
Gender	-1.222171	0.2297383	-5.32	0.000**
Caste	-0.122689	0.0954839	-1.28	0.199
IndependentRoom	-0.500189	0.2231010	-2.24	0.025*
Mobile	-0.463535	0.6048716	-0.77	0.443
Tablet	1.240407	0.8447653	1.47	0.142
PC	0.970338	0.5842075	1.66	0.097
Laptop	-0.121342	0.3235700	-0.38	0.708
DeviceOwnerCode	0.365894	0.1998225	1.83	0.067
AvailibilityofElectricity	-0.118763	0.1921091	-0.62	0.536
Youtube	-1.999567	0.4381815	-4.56	0.000**
EducationalWebsites	-0.510924	0.4476940	-1.14	0.254
EducationalApps	0.620659	0.2309380	2.69	0.007**
YoutubeUseful	0.249736	0.1559678	1.6	0.109
Educational WebsitesUseful	0.718548	0.1532507	4.69	0.000**
Video Conferencing Apps Useful	-0.142563	0.1152581	-1.24	0.216
Readingway	0.390279	0.2362956	1.65	0.099
Devices Enhanced learning	0.169491	0.1771462	0.96	0.339
Technical Problems inonlineclass	-0.26543	0.2158786	-1.23	0.219
Usefulness of Technology	-0.045167	0.1789673	-0.25	0.801
_cons	-1.089080	0.8490684	-1.28	0.200

*Note. *p<.05, **p<.01*

Hypothesis 1

Both socio-economic factors and technological factors affect the usefulness of technology in enhancing students' learning outcomes.

Through our study, we were able to ascertain that, socio-economic and technological factors did affect the extent to which technology was useful in enhancing the learning outcomes of students.

Pertaining to social factors, gender, place and independent room were found to be affecting the usefulness of technology among students.

With regards to gender, we found that girls are more likely to be effective in leveraging technology for enhancing their learning outcomes. Hence, they would benefit more from online courses as opposed to boys.

With regards to place, Bangalore and Mysore were found to be more conducive for implementing online courses. Incidentally, Bangalore and Mysore have the lowest incidence of poverty along with high-tier ICT infrastructure. So, in this backdrop, the extent to which online learning can help in addressing regional imbalances, particularly with regard to education, is an issue of concern.

With regards to privacy, from our study, we were able to infer that students who had access to independent study rooms were able to effectively use technology to enhance their learning outcomes.

Pertaining to technological factors, we were able to statistically ascertain that digital devices, ownership of digital devices, access to a better networks and availability of electricity enhanced the usefulness of technology in the students' learning endeavour.

Hypothesis 2

Online learning may not be equally effective for all educational streams.

From our study, we were able to infer that students belonging to the arts stream found online learning to be more conducive to enhancing their learning outcome, which was followed by students belonging to the commerce and science streams, respectively.

Hypothesis 3

The efficacy of Graduate and Postgraduate students is likely going to differ across different technological parameters pertaining to online learning.

From the binomial logit model, we were able to infer that graduate and postgraduate students did differ across different technological parameters pertaining to online learning. YouTube format of learning was likely to be more favoured by undergraduate students, and educational apps-based learning was more favoured by postgraduate students. In addition to that, from our study, we were able to infer that educational websites were more likely to be useful for postgraduate students.

Policy Implications

At the beginning of 2023, the University Grants Commission of India took the bold step of giving permission for 57 Indian Universities to run online undergraduate and postgraduate courses. For a vast country like India, in which the graduate and postgraduate populace comprises merely 8 per cent and 4 per cent of the total populace, the initiative undertaken by the University Grants Commission should be deemed commendable. When we observed the courses which were to be taught through online mode, there were courses pertaining to science, arts and commerce streams. Furthermore, the districts in which the Universities were offering the said courses spanned from rich to poor. In India, rich districts are characterized by superior socio-

economic infrastructure as compared to poor districts. In this regard, through the undertaken study, we wanted to analyze how feasible online courses were across different districts of varied economic prosperity, across different educational streams and across students of different educational levels. As the state of Karnataka was the first state in India to implement a new National Education Policy, we chose to conduct our study in the different districts of the state of Karnataka, spanning from districts having the lowest incidence of poverty to districts having the highest incidence of poverty. Through analyzing the students who had undergone at least one semester of full-fledged online courses during the COVID-19 pandemic across different districts of Karnataka, we wanted to analyze the feasibility of the implementation of online graduate and postgraduate courses. The policy implications of our study with regard to the technical, academic and social feasibility of the courses are summarized as follows:

1. **Subsidizing online education for girls**

   In India, there is conspicuous gender divide in among boys and girls in social, economic and academic dimensions. Through our study we noted that the girls were able to leverage technology in a better manner to enhance their learning outcome as opposed to boys. In this backdrop, if girls were to be subsidized by government for online education, it could help in bridging the gender divide and heralding inclusive social development.

2. **Create conducive tele commnication infrastructure in districts with high incidence of poverty**

   Further, when it came to districts under consideration, through our study, we were able to analyze that online education was more conducive to districts like Bangalore and Mysore, which incidentally had the lowest incidence of poverty. Being economically well-off districts, they have better ICT infrastructure. Thus, online learning is bound to be more effective in districts with better ICT infrastructure. Through our research, we were able to ascertain that better network facilities and better availability of electricity enhanced the learning outcomes of students. Thus, to enhance the efficacy of online learning, the government must enhance the infrastructural facilities pertaining to ICT in districts with higher incidences of poverty.

3. **Provide digital gadgets to students**

   Through our research, we were able to infer that the usefulness of technology among students not only depended on using digital devices but also depended on the ownership of digital devices. In this regard, if the concerned state governments could either subsidize or provide credit lines for students pursuing online courses to procure their own digital gadgets, particularly for students who are residing in districts with high incidences of poverty, that initiative could go a long way in enhancing the effectiveness of online learning among students.

4. **Full-fledged online Under-graduate and Postgraduate courses are more conducive for students pursuing subjects of arts stream rather than those of commerce or science.**

   Through our research, we were able to infer that students

pursuing arts or humanities streams felt more comfortable in leveraging technology for online learning as opposed to students pursuing commerce or science. This does seem logical, as teaching theoretical subjects would be easier to teach and learn through online mode. Hence, we would recommend full-fledged online programmes for theoretical subjects rather than technical or lab-oriented subjects,

5. **More interactive online curricula are required for undergraduate students**

   Through our study, we were able to infer that educational apps and YouTube enhanced the learning outcomes of students. Thus, while designing online courses for undergraduate students, it would be better for the Universities to compose relatively more audio-visual-based interactive content rather than just online literary material for students pursuing undergraduate courses. This would enhance the learning efficiency among undergraduate students (Hegeman, 2015; Trespalacios et al, 2020;).

6. **Professional Development for Educators:**

   To ensure the success of online education, there is a pressing need to invest in the professional development of educators. Training programs should focus on effective online teaching strategies, digital pedagogy, and the use of technology in the classroom. Supporting teachers in adopting innovative teaching methods will enhance the overall quality of online courses and improve student outcomes.

7. **Monitoring and Evaluation of Online Programs:**

   Establishing robust monitoring and evaluation frameworks for online courses is essential (Kumar and Rangappa, 2021; Keskin et al, 2023[a]). Regular assessments should be conducted to measure the effectiveness of these programs, identify areas for improvement, and ensure that educational standards are maintained. Feedback mechanisms involving students and educators can provide valuable insights for continuous improvement, ensuring that online education remains relevant and effective in meeting learners' needs.

8. **Incorporating Local Context and Relevance:**

   Online curricula should be designed to incorporate local context and cultural relevance to better engage students (Goundar and Bimal, 2022). By integrating regional examples, case studies, and local languages, universities can make online learning more relatable and effective for students from diverse backgrounds. This approach not only enhances engagement but also fosters a sense of belonging among students.

9. **Promoting Lifelong Learning and Skill Development:**

   Given the rapid changes in job markets and industry requirements, online education should focus on lifelong learning and skill development. Institutions should offer flexible online courses and modules that cater to working professionals and non-traditional students looking to upskill or reskill. Promoting such initiatives can help bridge the gap between

education and employability, ensuring that learners remain competitive in the workforce.

Conclusion and Way Forward

India is a vast and diverse country. Education in India is not just about knowledge, but it is also about social mobility along with a chance of having a better life and livelihood. At the same time, providing quality education for the emerging aspirational middle class is no less a daunting task for the nation and its government. In this regard, commencing full-fledged online courses by traditional universities can not only help provide affordable education for the masses but also help increase the productivity and efficiency of talented and gifted teachers. In this light, the permission provided by India's University Grants Commission for 57 Indian Universities to run full-fledged online graduate and postgraduate courses is truly a commendable step in the right direction. The online courses are supposed to start from the academic year 2023-24 onwards. Our research was a preemptive analysis to evaluate the feasibility of such a program based on the responses taken from undergraduate and postgraduate students who were forced to undergo online courses during the COVID-19 pandemic for at least one semester. Subsequent cross-sectional studies across various regions and states would shed more light on the issues that need to be addressed to enhance the efficacy of such online programs. Regardless of the issues to be ironed out, few would disagree about the potential of online courses to promote inclusive education, particularly in a vast and diverse country like India. Further cross-sectional studies across regions and states will be essential to address any gaps and ensure that online education fulfils its potential to promote inclusive education. While some issues undoubtedly need to be resolved, the potential of online courses to democratize education and improve access for underserved populations in India is widely recognized. In a country as diverse as India, online education holds the promise of expanding opportunities and breaking down barriers, making education more accessible to all.

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