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Evaluating ICT-Based Interventions in Higher Education during COVID-19: Some Preliminary Results

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Abstract

Purpose

The purpose of the paper is to predict whether or not ICT-based interventions in the higher education sector in India introduced during the COVID-19 pandemic will be successful.

Design/Methodology/Approach

The study is based on primary data collected through questionnaires circulated electronically. The binary logistic regression technique was used to assess whether or not ICT-based interventions will be successful, where the term 'success' implies the students' ability to attend classes and examinations in virtual mode during the pandemic.

Findings

The preliminary findings of the paper suggest that the probability of success of ICT interventions is very high. The digital resources, devices, and quality of the network will significantly impact the success of such interventions. Awareness about the common service centres (CSCs) and training of the faculty are likely to have a positive effect on the success of ICT-based interventions.

Implications

The study suggests that policy interventions must be made by the government to ensure the availability, accessibility, and affordability of digital resources, together with ICT aids such as devices and a quality network. Awareness about the availability of CSCs and training of faculty will enable the better integration of ICT into the teaching-learning process as per the fitted model. The study emphasises higher allocations for the development of quality digital resources, CSCs, and training of faculty.

Originality/Value

No such study to explore an answer to the question: whether or not ICT-based interventions in higher education during COVID-19 will be successful has previously been undertaken.

Keywords

ICT, Digital Resources, Devices and quality of the network, Open Book Exam, Common Service Centres, Training of Faculty

Introduction

The spectacular success of the information technology (IT) industry in India in the 1990s stimulated interest amongst academicians on the potential role that information and communication technologies (ICT) could play in India's economic development. ICT implies a:

> "Diverse set of technological tools and resources used to transmit, store, create, share, or exchange information. These technological tools and resources include computers, the Internet (websites, blogs, and emails), live broadcasting technologies (radio, television, and webcasting), recorded broadcasting technologies (podcasting, audio, and video players and storage devices) and telephony (fixed or mobile, satellite, Visio/video-conferencing, etc.)"[1].

Literature suggests that there are several channels through which ICT can impact growth (Srinivasan and Kruger, 2005). It could be through a reduction of transaction costs (Singh, 2008) and the consequent efficient use of resources, or productivity gains (Jorgenson and Stiroh, 1999; Stiroh, 2002a, 2002b) or speedy delivery of services. However, the transformational impact of ICT in different sectors, including education, has become more vivid during the coronavirus pandemic (which was not the case earlier), and has forced the sectors into a new era. It is being felt that "while the technology of the 20th Century played a role in the physical spread of COVID-19, today's technologies have played a critical role in helping mitigate its impact" (Pontbriand, 2020)[2]. Pontbriand further hails the crucial role of emerging 4th industrial revolution technologies, such as mobile, wireless, high-speed networks, virtual reality, and Internet of Things (IoT) technologies, in helping mitigate and manage through this pandemic via new ways for humans to connect, to work, and to access basic services, in addition to playing a part in remote medical responses.

Undeniably, India's higher education was designed for face-to-face teaching and learning. However, there has been an abrupt shift from face-to-face learning to ICT-based learning or remote learning in the education sector across all countries during the lockdowns[3] to check the spread of the Coronavirus[4] pandemic. In the case of India, educational institutes have been closed for the past five months. It is heartening to note that the Government of India (GOI) had realised in the initial phase of lockdown itself that these shutdowns of educational institutions can be accommodated only for short periods. If the situation was to continue for long periods, then a dramatic change in the delivery of education services would be required. With this understanding, the University Grants Commission (UGC)[5] periodically issued several notices and circulars and higher education institutes were advised to introduce ICT-based interventions in the form of online classes. They were also advised to use digital resources and digital platforms to ensure 'learning continuity' from March 2020 onwards[6].

[1] http://uis.unesco.org/en/glossary-term/information-and-communication-technologies-ict.
[2] https://www.csrwire.com/press_releases/45068-Technology-s-Role-in-this-Modern-Pandemic-Past-Present-Future
[3] "Some countries have opted for partial lockdowns (Sweden); others for a complete lockdown (India). Singapore, Hong Kong, and Taiwan have adopted non-pharmaceutical initiatives, including social distancing and travel restrictions. Some have declared an emergency (Japan), and China, which is now apparently emerging out of the crisis, is relaxing restrictions and claiming normalcy" (Joshi, 2020. See https://www.eurasiareview.com/02052020-could-covid-19-further-endanger-multilateralism-analysis/).
[4] As the World Health Organization (WHO) states, "Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus".
[5] India's higher education is managed by the University Grants Commission (UGC) and various Councils. The UGC, established by a statute in 1952, has been empowered to promote and coordinate university education in India and approve grants to them.
[6] COVID-19 was declared a pandemic by WHO on 11 March 2020, even though it was first noticed in China in December 2019.

Gradually, even an online system of examination was designed and introduced in the form of open-book examinations (OBE)[7] at the University of Delhi (India)[8] from 10 August 2020. The Open Book Evaluation portal was also created for the online evaluation of answer scripts. These response measures are commendable steps for reforming the higher education sector and making it pandemic resilient[9].

There has been growing realisation during the COVID-19 pandemic that this global health crisis, followed by 'learning crises' (due to disruptions caused by closure of schools and other educational institutes) might aggravate already existing 'human capital deficit' and mar the possibility of a country's economic revival. Therefore, countries across the globe have been using 'high tech, low tech, and no tech approaches' to ensure learning continuity. Interventions in the form of text messages to utilising social media platforms (such as WhatsApp and YouTube channels), broadcasting media (such as radio and television), and digital platforms (such as Google Classroom, Google hangout, *The Google Loon Balloons* [as in Kenya] and video-based collaboration services like WebEx, Zoom, Loom, Skype, Microsoft Teams, etc., and learning management systems [in India]) seem to be replacing the established ways of communication with technology-enabled interfaces (World Bank, 2020). Virtual classes, virtual conferences, and virtual exhibitions have become the order of the day as we move into a COVID-19 impacted world. Before the onset of the COVID-19 pandemic, various kinds of ICT products having relevance to education, such as email, audio conferencing, teleconferencing, television lessons, radio broadcasts, interactive radio/online counselling, etc., were used in education for different purposes (Sharma, 2003; Sanyal, 2001; Bhattacharya and Sharma, 2007). However, their use increased many times over during lockdown and the subsequent shutdown of schools, colleges, and universities during the pandemic to ensure the delivery of education services.

[7] Mock tests were conducted at the University of Delhi so that students could practice with the procedure. These included downloading of question papers, writing of answers on either plain or ruled white A4 paper, scanning of answer sheets and uploading of answer sheets to the portal (see: http://www.du.ac.in/du/uploads/COVID-19/MOCK%20TEST%20DATE%20SHEET-3.pdf).

[8] As stated in the All India Survey of Higher Education (AISHE) 2018-19, 993 Universities, 39,931 Colleges, and 10,725 Stand Alone Institutions were listed on the AISHE web portal. Enrollment stood at 27.2 million in important programmes at undergraduate (UG) and post graduate (PG) level in regular mode in India.

[9] It is important to quote here the words of Larry Brilliant, an American epidemiologist who helped to eradicate smallpox as a doctor working for WHO in the 1970s. He warned us in 2009 that: "The threat of deadly new viruses is on the rise due to population growth, climate change and increased contact between humans and animals". He believed that this is an 'age of pandemics' (see https://www.wsj.com/articles/SB124121965740478983). If his words are taken seriously, then the policymakers, together with the participation of all stakeholders, must start thinking of contingency plans for higher education and formulating digital strategies .The time has come to prepare response strategies for disasters like COVID-19.

Indeed, ICT facilitates learning by improving communication between students and instructors (Valasidou and Bousiou et al., 2005) and improves academic performance (Attwell and Battle, 1999; Woessman and Fuchs, 2004). Studies recognise that ICT has the potential to enhance skills, motivate students, integrate knowledge acquired with work, strengthen the teaching-learning process, and help teachers' prepare the students for future lives and careers (Davis and Tearle, 1999; Lemke and Coughlin, 1998, Hariss, 2002; Wheeler, 2001). The strengthening of the teaching-learning processes and acquisitions of the skillsets becomes all the more important when both tech and non-tech companies encouraged remote working and going digital[10] during COVID-19.

ICT integration in education has been drawing a lot of attention, especially after the onset of COVID-19. Only a few studies have been done focusing on ICT integration in education in the pre-COVID-19 period (Chowdhury et al., 2018; UNESCO, 2007; Blurton, 1999). ICT has come to play a central role in the teaching-learning process during the pandemic, and its integration in education carries a huge potential to build innovative culture, student-centred pedagogical goals, and collective learning (Lloyd, 2005).

Although there are a few studies on the impact of ICT integration in higher education in other countries, and in the pre-COVID-19 period (Chowdhury et al., 2018; Yusuf, 2005), to the best of our knowledge, no research has been carried out on the probability of the success of ICT interventions introduced in the higher education sector during the COVID-19 pandemic. This study aims to fill this gap in the literature. It will be appropriate to examine our research question by gathering information from final (i.e., third) year students at the undergraduate (UG) level. Our research question is, what is the probability of success of ICT interventions made by the University Grants Commission from March 2020[11] in the teaching-learning process and, recently, those made in the examination system[12] by devising and introducing an open book exam (OBE) at the University of Delhi. Such a study can inform policymakers about the future course of action concerning ICT interventions in higher education. After an introduction, the next section will focus on data and methodology. The following section presents the results and discussion and the final section concludes and offers policy recommendations.

[10] Tata Consultancy Services (TCS), an Indian company that is a global leader in IT services, consulting & business solutions, is thinking of implementing a new operating model called 25/25 (discarding its old operating model). The name means that by 2025 only 25% of the workforce will attend the office and the remainder will work from home (see: https://www.indiatvnews.com/business/news-tcs-work-from-home-75-percent-employees-2025-612357).

[11] Advice for Universities and colleges recommending preventive measures to combat the threat of COVID-19 and highlighting the need for a coordinated and collective effort in a mission mode started 5 March 2020.

[12] OBE started in DU from 3 August 2020.

Data and Methodology

This study is based on primary data collected through questionnaires circulated electronically to 450 students appearing for final year examination at the undergraduate level at the University of Delhi (DU)[13]; responses were received from 257 respondents. The dichotomously coded dependent variable is whether or not the ICT interventions at the undergraduate (UG) level will be successful. The term 'success' has been defined as the students' ability to attend classes and examinations in virtual mode during the pandemic. The probability of success of the ICT interventions was assessed using binary logistic regression.

The chosen binary logistic regression model with multiple predictor variables is:

$$\text{Logit}(p)= \log(p/(1-p))= \beta 0+\beta 1\text{DIGIRES}+\beta 2\text{DNW}+\beta 3\text{CSC}+\beta 4\text{TRT}+e$$

When we apply such a model to our dataset, each estimated coefficient (i.e.b's) is the expected change in the log odds of ICT-based interventions being successful for a unit change in the corresponding predictor variable holding other predictor variables constant at a certain value. The b's are the partial logistic regression coefficients, and 'se' are the standard errors of the partial slope coefficients. The z-ratio is the regression coefficient divided by its standard error (se), p value is its corresponding probability value, and the odds ratio is the exponentiated slope coefficient.

[13] Please refer to Appendix Figure 1 for understanding India's education structure.

Selected Independent Variables

Logistic regression analysis was utilised to predict whether ICT intervention in the form of remote learning and OBE, etc., would be successful or not. Understandably, there are certain prerequisites for the success of ICT-based interventions made in the higher education sector during the COVID-19 pandemic. The first and foremost pre-requirement is the availability of digital resources[14] or e-content, followed by the devices and network quality. Indeed, ICT interventions cannot be successful unless and until digital resources, devices (smartphones, laptops, etc.), and quality networks are made available, accessible, and affordable for holding online classes and conducting examinations and evaluation. The provision of Common Service Centres (CSCs) for ensuring connectivity infrastructure to deprived sections of society is in keeping with the principle of 'equity' and 'inclusion'. In addition, faculty's training or skill sets are a must to ensure the delivery of education services and better learning outcomes. These four variables are the independent variables in this model. The selection of independent variables for the present investigation was determined primarily by logic, then by the level of support received in the literature (Bottino, 2003; Kulik, 2003; Webb and Cox, 2004; Kozma, 2005; Plomp et al., 2007). The dichotomous dependent variable is whether or not the ICT interventions at the UG level would be successful; they are coded as =1, if successful and =0, if not successful.

[14] There is no dearth of e-learning resources in India as the SWAYAM (Study Webs of Active-Learning for Young Aspiring Minds) portal of GOI is one of the largest platforms in the world; this hosts 1,900 technical and non-technical courses.

Findings and Discussion

The results of the binary logistic regression analysis for ICT interventions at the UG level are presented in Table 1.

Table 1: Binary Logistic Regression of Probability of Success of ICT interventions at UG level

Independent Variable	b	se	z-ratio	p value	Odds Ratio
Digital Resources (DIGIRES)	1.8	0.332	5.41	0.000*	6.054
Devices and quality of network (DNW)	0.606	0.317	1.91	0.057**	1.833
Awareness about Common Service Centre (CSC)	0.14	0.622	0.23	0.821	1.15
Training of Teachers'(TRT)	0.296	0.435	0.68	0.496	1.345
Constant	-0.382	0.44	-0.87	0.384	0.681
Model Chi-square (χ^2) (p value)	0.000	p<0.05			
Pseudo R2	0.1404				
n	257				

Note: i) The dependent variable in this analysis is ICT interventions at the UG level so that 0=Not successful and 1= Successful

ii) * indicates 0.01 level of significance, **indicates 0.10 level of significance.

ii) The b's are the partial logistic regression coefficients and 'se' are the standard errors of the partial slope coefficients, the z-ratio is the regression coefficient divided by its standard error, p value is its corresponding probability value, and the odds ratio is the exponentiated slope coefficient.

Source: Based on author's calculations from the primary survey

The interpretation of the logistic coefficient is more difficult than in the case of multiple linear regressions. It can be observed from the table given above that instead of the conventional Beta coefficient, the logistic model is rewritten in terms of the odds of an event occurring, defined as the ratio of the probability that an event will occur to the probability that it will not. In other words, it shows the chances of success against failure under specific conditions of the data. It plays an important role in “logistic regression”.

Factors with values greater than one indicate that the odds are increased; those with values less than one indicate that the odds are decreased. Out of the four independent variables, namely DIGIRES, DNW, CSC, and TRT, available to the regression solution, the partial logistic regression coefficients of only two of them, viz. DIGIRES and DNW, bear a statistically significant relationship to the dependent variable, i.e., prediction of success of ICT interventions at the UG level. The partial logistic regression coefficients of the remaining two variables bear correct positive signs, indicating the positive impact of CSCs and TRT on logit or log-odds/log of the odds.

The predictor DIGIRES entered the model first. The value for the odds of this variable indicates that, as the DIGIRES is increased, the odds of ICT intervention’s success increase by a factor of 5.05 (or 505%). The DNW also contributes to the prediction of the success of ICT interventions; as the availability and quality of network improves/increases, the odds of success of ICT intervention increases by a factor of 0.83 (or 83%). The availability of CSC and TRT also help in the prediction of the success of ICT interventions; however, their coefficients are not found to be significant.

Results for ICT interventions indicate that digital resources and devices and the quality of the network will significantly impact the success of such ICT interventions. Awareness about the CSC and skillsets of the faculty have a positive effect on the success of ICT interventions.

Table 1 also shows the model chi-square value (roughly analogous to the F-test in case of Ordinary Least Squares) and the pseudo-R-squared value (roughly analogous to R-squared) as measures of goodness of fit. Since the p-value is less than 0.05, the model is therefore a good fit.

Conclusions and Policy Recommendations

After electronically collecting information from 257 students (out of 450 students) that were sent the questionnaire) appearing for final year examination at the undergraduate level in the colleges affiliated to the University of Delhi and using a logistic regression. The paper suggests that digital resources, devices, and quality of the network will significantly impact the success of such ICT interventions made for teaching and conducting an examination. The term 'success' means the students' ability to attend classes and examination in virtual mode during the COVID-19 pandemic. Therefore, attention must be paid by the government to develop and ensure the availability of quality digital resources to everyone. In addition, the availability of devices, the quality of the network will also matter. Therefore, there is a need for a target-oriented approach towards resolving the twin problems of availability of digital resources and devices, and network connectivity. This is especially true for the vulnerable sections of society and underprivileged students living in hilly terrains or tribal and backward areas; there is a need to check the 'digital divide' and to tap the 'digital dividend'.

Higher allocations should therefore be made by the government for the development of quality digital resources, CSCs and training of faculty. There is also a need to spread awareness about the availability of CSCs. Since the skill-sets/training of the faculty have a positive effect on the success of ICT interventions, there is a need for investment in training of faculty who are the agents of change in reforming education. Awareness about the availability of CSCs and training of faculty will enable the better integration of ICT into teaching-learning processes. It is important to emphasise that proper and quality training for faculty is imperative to enable them to navigate online platforms, including accommodating the interests of persons with disabilities, and building a healthy and resilient cyber ecosystem. Various initiatives of the Government of India must be accompanied by equity-oriented policies, frameworks and targeted funding to assist at-risk students[15] .

[15] https://blogs.worldbank.org/education/covid-19s-immense-impact-equity-tertiary-education.

There is a need for private sector participation to improve the financing of a digital curriculum and materials (digital libraries, lessons, learning items, etc.). This is the time to forge partnerships with the private sector, with chambers of commerce and industry to expand national, state and district level capacities to ensure the remote provision of education, and for raising the gross enrolment ratios (GERs) so essential for building human capital and ensuring the prosperity of our country. This can help us in achieving our long cherished goal of 'Education for All' and Sustainable Development Goal 4, which aims at ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all. The new technical co-operation agreements for crisis sensitive planning need to be done at the regional and international levels to anticipate risks and act in advance to check the loss of lives and recovery costs. It is imperative to mobilise all major telecom service providers to boost Internet connectivity services for online education, especially for the underprivileged and backward regions.

Although this study brings to the fore interesting findings, it will not be out of place to mention here some of its limitations. A small database of only 257 observations precludes much of the generalisability of the study's findings. Studies of a similar kind with larger sample sizes need to be replicated in other state and Central Universities to draw parallels as well as contrasts in the experience of these universities. In addition, although not included in this study, the two important parameters, namely cyber security issues and psychosocial support systems, constitute two important parameters that need to be examined before coming to the final judgment about the success of ICT interventions at the UG level.

The almost sudden transition to ICT-based learning or remote learning may have come as a surprise to many amidst COVID-19, but if ICT-based interventions are implemented properly and effectively during the COVID-19 pandemic, this can help to resolve the socio-economic and technological issues associated with ICT-based learning/education. Seemingly, going digital is the way forward for the education sector.

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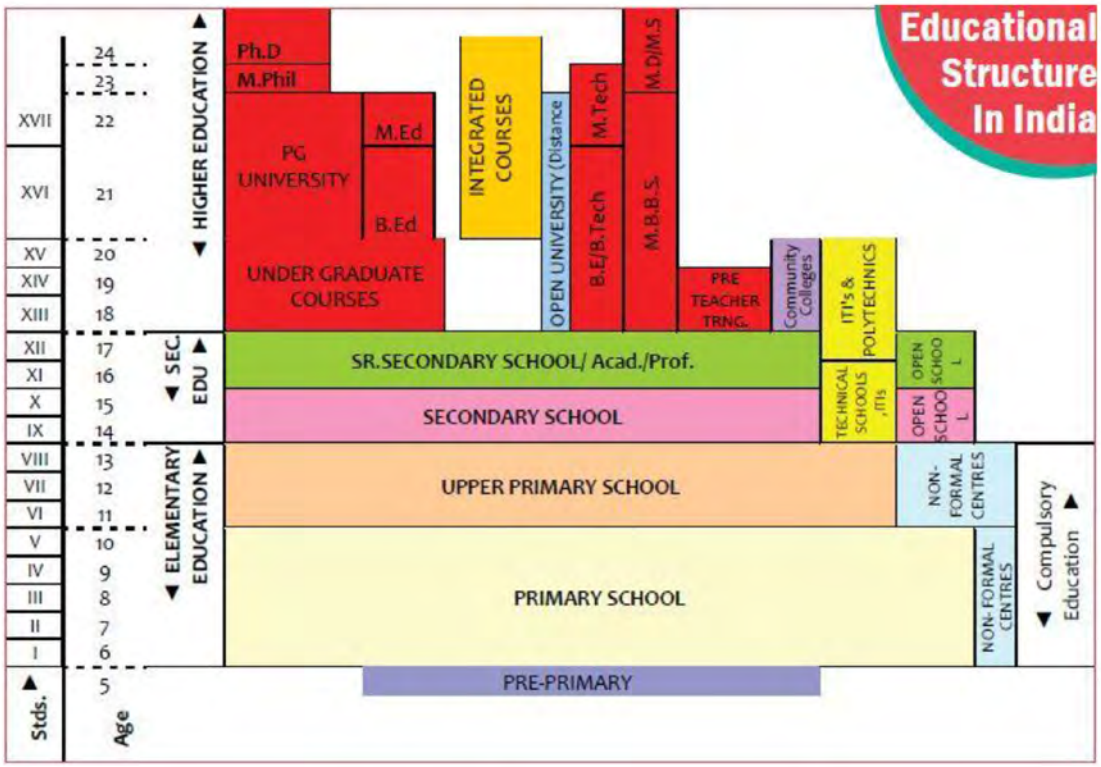
Appendix

Figure 1: Education Structure in India



Source: Reproduced from University Grants Commission (2018), *Higher Education: All India & States Profile 2017-18*. Secretary, University Grants Commission Bahadur Shah Zafar Marg, New Delhi

Biography

Dr Seema Joshi is an Associate Professor of Economics, Department of Commerce at Kirori Mal College, University of Delhi. She has authored 2 books, 50 research papers and articles that have been published in reputed Indian and international journals and books. Dr Joshi honed her expertise while working at respected policy and research organisations in India and abroad. She was the first Sir Ratan Tata Post-Doctoral Senior Fellow (2007-08) at the Institute of Economic Growth, and ICCR's First Tagore Chair Professor to Vietnam in 2011-12.

Dr Joshi has conducted six training programmes for scientists, public sector executives and senior bureaucrats during her deputation to the IIPA from 2005-07. She has advised the government and chambers of commerce as a member of their expert committees and served as a 'Women Community Representative' in the selection committee of an Indian PSU.