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Digitisation of Education in India during the Pandemic: Effectiveness and Challenges

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Abstract

The first online learning systems were set up to deliver information to students. With the introduction of the computer and internet in the late 20th century, e-learning tools and delivery methods expanded. The evolutionary changes in educational technology and pedagogy leading to revolutionary transformation of education during the pandemic is a matter of discussion and concern in a country like India due to digital divide. The objective of this paper is to examine the effectiveness of online teaching-learning process in higher education. Factor Analysis is used to estimate an index (Online Education Efficacy Index). To determine the effectiveness of online education difference-in-difference estimator is used. The study employed purposive sampling method. The sample size is 350. This paper analyses the importance of online education for students of higher education in order to create opportunities to provide access to education to overcome the challenges faced by the students during the pandemic due to closure of colleges and universities in India. The paper also identifies the challenges of online education and tries to provide recommendations to overcome the challenges like role of the government to reduce the digital divide, enhance the scope of public-private partnership in providing the infrastructure to facilitate effective online education.

Keywords: online education, higher education, effectiveness, digital divide, challenges

Introduction

In the last 20 years, the Internet has grown from being nearly non-existent into the largest, most accessible database of information ever created. It has changed the way people communicate and think about knowledge and learning. Online education is an electronically supported learning that relies on the Internet for teacher-student interaction and the distribution of classroom materials. Sarah Guri- Rosenbilt from the Open University of Israel explored the exact definition of e-learning in great detail in her 2005 research paper

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"'*Distance Education' and 'E-Learning': Not the Same Thing*". She defined e-learning as electronic media used for various learning purposes ranging from conventional classroom add-on functions to online substitution for face-to-face meetings with online encounters**.** Clark and Mayer defined E-learning as instructions delivered through digital devices with the intent of supporting learning in their 2016 research paper "*E-learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning."*Arkorful and Abaidoo defined e-learning as using information and communication technologies for enabling access to online teaching and learning resources in their 2015 research paper "*The role of e-learning, advantages and disadvantages of its adoption in higher education*." Ruiz, Mintzer and Leipzig defined e-learning as using Internet technologies for enhancing performance and knowledge in their 2006 research paper "*The Impact of E-Learning in Medical Education."*

Online learning has many advantages. It helps students to make use of self-paced learning and choose their own learning environments. It is both cost- effective and cost- efficient as it removes the geographical obstacles which are associated with traditional classroom teaching-learning process. Conducting any of the various types of e-learning through the Internet means sacrifices in one way or another. Increased risk of cheating during assessments, social isolation, and lack of communicational skill development in online students are just some of the challenges of e-learning which need to be addressed. The future of online learning will continue to see exponential growth. Although it might gain prominence in the developed nations of the world, the growth of this mode of education in the developing countries like India, particularly in the rural areas is highly doubtful due to lack of resources. The transition of the mode of education from physical classes to online was a like a random shock to the rural areas and even in government aided and government schools and many higher educational institutions of urban areas causing wide fluctuations in the learning process. The education sector is very badly hit by the pandemic due to non-availability of appropriate mechanisms to shift to online mode of education thus widening the digital divide further in India. Online teaching-learning process has become a complete substitute for traditional face-to-face classroom teaching. But this has become a very big challenge in India, where a considerable percentage of the students are denied access to this mode of education due to digital divide. The learning quality depends on the level of digital access and efficiency. The online learning environment varies profoundly from the traditional classroom in terms of motivation, satisfaction and interaction. With the

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imposition of lockdown in India, the major concern was the quality of learning which depends on the design and execution of the content. While some believe that the unplanned and rapid move to online learning – with no training, insufficient bandwidth, and little preparation – will result in a poor user experience that is unconducive to sustained growth, others believe that a new hybrid model of education will emerge, with significant benefits. Therefore, it is of immense significance to evaluate the effectiveness of online teaching-learning process during the pandemic in India which never took such gigantic proportions before. Since there was no preparedness on both the part of the students and teachers, it is imperative to identify the constraints faced by them.

Objectives

The objectives of this paper are to

1. Estimate the Online Education Efficacy Index using Factor Analysis
2. Determine the effectiveness of online education using difference-in-difference estimator.

Overview of Literature

Lockdown and social distancing measures due to the COVID-19 pandemic have led to closures of schools, training institutes and higher education facilities in most countries. There is a paradigm shift in the way educators deliver quality education—through various online platforms. The online learning, distance and continuing education have become a panacea for this unprecedented global pandemic, despite the challenges posed to both educators and the learners. Transitioning from traditional face-to-face learning to online learning can be an entirely different experience for the learners and the educators, which they must adapt to with little or no other alternatives available. There is no one-size-fits-all pedagogy for online learning. There are a variety of subjects with varying needs. Different subjects and age groups require different approaches to online learning. The flipped classroom is a simple strategy for providing learning resources such as articles, pre-recorded videos and YouTube links before the class. The online classroom time is then used to deepen understanding through discussion with faculty and peer (Doucet et al., 2020).

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Online learning also allows physically challenged students with more freedom to participate in learning in the virtual environment, requiring limited movement (Basilaia & Kvavadze, 2020).

Many students at home/living space have undergone psychological and emotional distress and have been unable to engage productively. The best practices for online home schooling are yet to be explored. The use of suitable and relevant pedagogy for online education may depend on the expertise and exposure to information and communications technology (ICT) for both educators and the learners (Petrie, 2020).

Broadly identified challenges with e-learning are accessibility, affordability, flexibility, learning pedagogy, life-long learning and educational policy (Murgatrotd, 2020). Many countries have substantial issues with a reliable Internet connection and access to digital devices. While, in many developing countries, the economically backward children are unable to afford online learning devices, the online education poses a risk of exposure to increased screen time for the learner.

The level of academic performance of the students is likely to drop for the classes held for both year-end examination and internal examination due to reduced contact hour for learners and lack of consultation with teachers when facing difficulties in learning/understanding (Sintema, 2020).

It is also possible that some students' careers might benefit from the interruptions. A study carried out in France shows that the 1968 abandoning of the normal examination procedures in France, following the student riots, led to positive long-term labour market consequences for the affected cohort (Maurin & McNally, 2008).

Authentic assessments and timely feedback are essential components of learning. A very crucial part of online distance learning is the availability of helpful formative assessments and timely feedback to the online learners (Doucet et al., 2020). This is found to be challenging for the educators and the education system.

There are a large number of studies that find positive statistically significant effects for student learning outcomes in the online or hybrid format compared to the traditional face-to-face format. Navarro and Shoemaker (2000) found that student learning outcomes for online learners were as good as or better than traditional learners regardless of background characteristics and that the students were greatly satisfied with online learning. Rovai and

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Jordan (2004) examined the relationship of sense of community between traditional classroom and the blended format, and they found that students in the blended format had a stronger sense of community than students in the traditional format. Harmon & Lambrinos (2006) found that after correcting for sample selection bias, test scores for the online format students were four points higher than for the traditional format. Bowen & Ithaka (2012) found that there are comparable learning outcomes for both groups and that there was the promise of cost savings and productivity gains over time for the hybrid course. As online learning grows, more and more aspects of "gamification," the use of game mechanics and virtual achievements in non-game contexts to engage users, are being added to the virtual environment to increase task engagement and decrease attrition (Deterding, Dixon, Khaled, & Nacke, 2011; Huotari & Hamari, 2012; Kapp, 2012). Even though there are positive findings for the effectiveness of online learning, it is still unclear that this generally holds true across studies. Bernard et al., (2004) and Clark (1994) concluded that the combination of time spent, curriculum, and pedagogy in the online format produced the observed difference in learning outcomes, but there was no evidence that online learning is superior as a medium for learning, which is consistent with prior literature. Bernard et al. (2004) found that overall, there was no significant difference in achievement, attitude, and retention outcomes between distance education, which included online education, and the traditional face-to-face education. However, there was significant heterogeneity in student learning outcomes for different activities. For instance, a recent systematic review comparing the learning of clinical skills in undergraduate nurse education between the online format and the traditional found that there was no significant difference between the two formats (McCutcheon, Lohan, Traynor, & Martin, 2015). In 2005, a year after Bernard et al. published their study, another group published an analysis on the effectiveness of distance education.

The Mixed and Negative Findings compared to the number of studies that found positive or no significant effects for student learning outcomes in the online format, the number of studies that found mixed or negative significant effects is much smaller, by a full order of magnitude. Some of these studies are direct contradictions of the studies with positive results: they find that students performed worse in the online format compared to the traditional format. Some studies' findings are more nuanced. They find that there are negative effects for certain groups of students and null findings for others. There are studies that systematically examine the ubiquitous self-selection bias of online learning: the

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endogeneity of learning environment choice. Most studies on distance or online learning do not examine this selection bias, which some researchers posit as a culprit for the "no significant difference" phenomenon. In a study that compares student learning outcomes in a microeconomics course, Brown and Liedholm (2002) found that students in the online format performed significantly worse on tests than the students in the traditional format even though they had better GPA and ACT scores. This difference was most pronounced for complex questions and least pronounced for basic questions. One possible explanation was that half of the online students reported to spend less than three hours per week and none claimed to spend more than seven hours per week, while half of the students in the traditional format attended every class, a minimum of three hours per week. The differences in time devoted to class or active engagement resulting in differential outcomes were also found in another study (Hiltz et al., 2000). Brown and Liedholm (2002) also found that female students performed significantly worse, six percentage points worse, than male students in the traditional format, but there was no significant difference for the sexes in the online format. Other studies have also found that sex is a moderating variable for student learning outcomes when comparing online and traditional formats (Figlio, Rush, & Yin, 2010; Xu & Jaggars, 2013). There is strong evidence for the heterogeneous outcomes of the effects of online learning, and in particular, a number of student characteristics such as sex, race/ethnicity, and ability, can moderate the learning outcomes. Moreover, there are other factors such as the existence and structure of learning communities, the type of online learning activities, varied materials, formative assessment, and the level of students' active engagement also play critical roles in determining the outcomes of the two formats (Blitz, 2013; Brown & Liedholm, 2004; Hiltz et al., 2000; Tsai, Tsai, & Lin, 2015; Wang et al., 2006). For instance, Brown and Liedholm (2004) found that there was considerable diversity in both the order in which students used course materials (ranging from textbook, media-enhanced PowerPoint slides, video lectures, interactive and individualized Excel-based practice problems, and repeatable, low-stakes practice questions) and the value they placed on different materials for learning. They concluded that additional tools and variegated materials in a course would be more beneficial than the exclusion of them.

Methodology

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The study employed purposive sampling method. This is deliberately a non-random method of sampling which aims to sample a group of people or setting with a particular characteristic. The sample is selected on the basis of individual judgement of the sampler. There is no special technique for selecting a purposive sample. The respondents are selected because they have knowledge that is valuable to the research process. This ensured that the respondents who had access to online learning process and all those who did not have access were selected. The sample is drawn from urban, semi-urban and rural regions of West Bengal. The respondents belong to the age group 18 – 23 years. The respondents are either male or female studying in government-aided institutions or private institutions. They are either pursuing higher studies in non-IT related discipline or IT-related discipline. The respondents who had access to online learning process is the treatment group and the those who did not have access is the control group. A well-designed questionnaire was circulated online to undergraduate and postgraduate students of West Bengal. The respondents of the control group were interviewed over telephone. The sample size is 385. The treatment group consists of 283 respondents and the control group has 102 respondents. There are two time periods for both the treatment group as well as the control group to study the impact of online education.

Sample selection is not considered a problem in randomized experiments because randomization renders selection effects irrelevant. Hence, the treatment effect model is applied to check for sample selection problem. In order to understand the effectiveness of online education, online education efficacy index is first estimated using Principal Component Analysis. After estimation of the online education efficacy index the study involves difference-in-difference estimator for understanding the effectiveness of online education during the pandemic and analyse the difference between online education and conventional classroom teaching. This methodology is applied because the data for this research arises from a natural experiment.

Analysis

Estimation of Online Education Efficacy Index Using Principal Component Analysis

It is insufficient to explain efficacy of online education by using only single variable because such descriptive analyses are based on a uni-dimensional assumption that a variable obtains

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no other relational and / or interrelation pattern with any other variable. Therefore, it is necessary to apply multivariate method which aims to find meaningful method of measuring empowerment. The primary advantage of multivariate technique is their ability to accommodate multiple variables in an attempt to understand the complex relationships which is not possible with univariate and bivariate methods. For this reason, 'Factor Analysis' is chosen as the method to examine the multidimensional relationships among the variables in this study. Factor Analysis is a generic name given to a class of multivariate statistical method whose primary purpose is to define the underlying structure in a data matrix. It addresses the problem of analyzing the structure of the interrelationships among a large number of variables by defining a set of common underlying dimensions known as factors. In this study, Principal Component Analysis is preferred for model building because this method attempts to reach a set of factors which can account for all the common and unique variance in a set of variables (Garson, 2003). The goal of PCA is to summarize the interrelationships among a set of original variables in terms of a smaller set of orthogonal principal components that are linear combinations of the original variables. Therefore, while choosing the variables, I have kept in mind that all variables describe a common phenomenon. The primary application that I was looking at in this paper is the efficacy analysis. PCA requires that the variables being examined be based on similar units of measurement. Therefore, it is customary to standardize (normalize) the variables when each variable has mean zero and variance one, so that PCA indeed analyses the dependencies among the variables rather than the differences in measurement scales. In order to normalize the values, there is a need to first identify the maximum and minimum values of each variable. To find out whether online education has been effective or not I have assigned values to the variables with the help of a three-pointer scale, thereby examining how discrete data can be appropriately used with PCA. If there are several categories of a discrete variable, they may or may not have some natural ordering. If they do, the discrete data are referred to as ordinal. When we turn to the ordinal data, a simple and naïve plug-in strategy would be to use the discrete x's as if they were continuous in the PCA.

If x is a random vector of dimension p with finite p x p variance-covariance matrix $\mathbf{V[x]} = \sum$, then the principal component analysis solves the problem of finding the directions of the greatest variance of the linear combinations of x's. In other words, it seeks the orthogonal set of coefficient vectors $a_{1,\ldots\ldots}, a_k$, such that

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$\mathbf{a_1 = arg\ max\ V\ [a^{/}\ x]}$

……

$\mathbf{a_k = arg\ max\ V\ [a^{/}\ x]}$ ……(1)

The linear combinations $\mathbf{a^{/}_k x}$ is referred to as the k-th principal component. The first principal component will have the greatest variance and extract the largest amount of information from the data; the second component will be orthogonal to the first one, and will have the greatest variance in the subspace orthogonal to the first component, and extract the greatest information in that subspace and so on. The solution to equation (1) is found by solving the Eigen problem for the covariance (or correlation) matrix ∑: find **λ's** and **a's** such that

$$\sum \mathbf{a} = \lambda \mathbf{a} \quad \text{…….. (2)}$$

The solution of the Eigen problem (2) for the covariance or more commonly correlation matrix gives the set of principal component weights **'a'** also referred to as factor loadings, the linear combinations $a^{/}$ x and the Eigen values $\lambda_1 \geq$ **……..** $\geq \lambda_p$. The linear combination that corresponds to the largest Eigen value is the one that has the greatest variance.

Let us first identify the variables used to measure efficacy of online education using PCA. To measure efficacy, I have used 21 variables to understand whether the students have benefitted from online education during the pandemic. There were other variables for general information of a respondent.

1. Ownership of a laptop, desktop or a smartphone
2. Mode of accessing the online class
3. Availability of Internet/Wi-Fi Connection at Home
4. Familiar with tools for online learning
5. Sufficient computer knowledge
6. Guidelines provided before online classes
7. Ease of using online tools
8. Happy about online classes
9. Frustration and lack of interest in online classes
10. Effectiveness of online classes vis-à-vis traditional classes
11. Gained experience in online learning
12. Flexibility in participating in online classes
13. Lack of direct contact with other students
14. Inconsistent communication with teachers

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15. High level of motivation in online class
16. Happy about student-teacher interaction
17. Facility to clear doubts
18. Teacher's personal attention is less
19. Suitable home environment for online classes
20. Possibility of distraction during online classes by family members
21. Blend of online and traditional classes after the pandemic is over

Since the main objective is to study whether online education has been effective or not, I had to make a comparative study of the treatment group with the control group. Running the PCA in the software package Stata, I have identified the Eigen Values which is more than one. The number of Eigen values above one varies from data to data. In my study there are four data sets –two for treatment group and two for control group at two different time periods. The two time periods are – May 2020 and May 2021. For this analysis we have used 'Orthogonal Rotations' as our objective is to reduce a larger number of variables to a smaller set of uncorrelated variables. In practice, the objective of all methods of rotation is to simplify the rows and columns of the factor matrix to facilitate interpretation. By simplifying the rows, we mean making as many values in each row as close to zero as possible (i.e., maximizing a variable's loading on a single factor). By simplifying the columns, we mean making as many values in each column as close to zero as possible (i.e., making the number of high loadings as few as possible). Three major orthogonal approaches have been developed – Quartimax, Varimax and Equimax. The Varimax method has been used in this analysis. Varimax criterion centres on simplifying the columns of factor matrix. This method maximizes the sum of variances of required loadings of the factor matrix. With the Varimax rotational approach, there tend to be some high loadings (i.e., close to -1 or +1) indicating a clear positive or negative association between the variables and the factor and some loadings near 0 in each column of the matrix indicating a clear lack of association. This structure is fundamentally simple.

To calculate the weights of the different variables for the treatment group (for both the periods) I have multiplied the 1st Eigen value with 1st Extracted Component Column, 2nd Eigen value with 2nd Extracted Component Column, 3rd Eigen value with 3rd Extracted Component Column, and the 4th Eigen value with 4th Extracted Component Column and so on and then summed them up to obtain the weight. I have considered absolute values (irrespective of sign, negative values are treated as positive). This process has been followed for the control group also.

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The following formula is used to determine the Online Education Efficacy Index:

$$\mathbf{OEEI} = \sum \mathbf{X_i} \left(\sum \left| \mathbf{L_{ij}} \right| . \mathbf{E_j}\right) / \sum \left(\sum \left| \mathbf{L_{ij}} \right| . \mathbf{E_j}\right)$$

Where the OEEI is online education efficacy index, X_i is i_{th} variable, L_{ij} is the factor loading of the i_{th} variable on the j_{th} factor, E_j is the Eigen value of the j_{th} factor. Thus, Table 1 reflects the online education efficacy index of control and treatment groups both in t^{th} and $(t+1)^{th}$ periods.

Table 1: Online Education Efficacy Index of Treatment group and Control group in t^{th} and $(t+1)^{th}$ period

SAMPLE	OEEI (2020)	OEEI (2021)
TREATMENT GROUP	0.36	0.56
CONTROL GROUP	0.21	0.21

Source: Calculated by author

There has been significant improvement in terms of online education for the treatment group during this one year but the efficacy of online education for the control group has not changed. The sample respondents of the control group belong to rural areas who failed to get access to online education particularly due to lack of access to internet facilities and devices. With sudden announcement of closure of educational institutions in West Bengal, initially many colleges even in urban areas faced glitches in conducting online classes. Gradually with the passage of time, it was possible to conduct online classes systematically and with lesser challenges in urban and semi-urban areas. But the problem persisted in the rural areas. The problem persisted in many colleges of urban and semi-urban colleges as well. The efficacy of online education was limited to those students of urban areas who had access to devices required for online education along with internet facilities. For those who had the facilities of online education, initially it was difficult for the students of urban areas to adapt themselves to online mode of education because there was lack of communication with the teacher, lack of motivation and interest, lack of classroom ambience, lack of proper attention due to different kinds of distractions at home, lack of direct contact with fellow mates, lack of flexibility in participative class discussions, lesser opportunity to clear doubts. The teachers were also not very comfortable with the online teaching mode as in most cases there were technical glitches and the teachers failed to

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understand the comprehension level of the students due to unresponsiveness of students which was due to lack of interest and frustration among students. But over time, increase in the level of responsiveness of students, improved level of communication of the students with the teachers, increase in motivation level among students due to improvisation of teaching mechanism by the teachers to make the teaching learning process interesting, improved level of adaptation for the teachers and students, realisation among students about the need to sustain with this mode of education as a substitute to classroom learning as there was no alternative, ability to overcome certain distractions during class hours due to various factors, ability to overcome the feeling of social isolation helped improve the efficacy of online education for the treatment group. Since the respondents of the control group did not have access to internet facilities and proper device for online mode of education, so there was no improvement in terms of efficacy of online education.

Assessment of Efficacy Using Difference-in -Difference Estimator

Pooled cross section can be very useful for evaluating the impact of a certain event or policy. In our survey the data arises from a quasi- experiment. A quasi experiment occurs when some planned exogenous event like any change in government policy can possibly change the socio-economic environment of the individuals or households. This quasi experiment always has a control group which is not affected by the policy changes and a treatment group which is thought to be affected by the policy changes. In this case it was not a planned event but can be treated similar to quasi experiment because with the closure of educational institutions it was imperative that online education was the only alternative to proceed with the teaching-learning process. Hence, the different universities started emphasising on this mode of education to facilitate students with the learning mechanism. In order to control for systematic differences between the control and treatment group I needed data for two years, one at the outset with closure of educational institutions and one after the change. To collect the longitudinal data, I made an attempt to follow the same individuals across time. Let the two time periods be denoted as t^{th} period and $(t+1)^{th}$ time period. These years are adjacent i.e. t^{th} period corresponds to 2020 and $(t+1)^{th}$ to 2021 in which year the actual impact have been measured. Thus, this sample is broken down into four groups, (i) the control group before the change, (ii) the control group after the change, (iii) the treatment group before the change and (iv) the treatment group after the change. In this '*before versus after'* comparison

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the time gap here taken is one year. We can call 'C' as control group and 'T' as the treatment group. DT is here treated as dummy variable and equal to 1 for those in the treatment group 'T' and 'zero' for control group. We here also consider D2 as the dummy variable for the second time period. So, the equation of our interest is

$OEEI_{it} = \alpha_0 + \alpha_1 D2 + \alpha_2 DT + \alpha_3 D2DT + u_{it}$ .....(3)

Here α_3 measures the effect of the policy. Without other factors, in the regression $\widehat{\alpha_3}$ is the difference-in difference estimator. It is also called average treatment effect because it measures the effect of the 'treatment' or policy on $OEEI_{it}$. In the model $\widehat{\alpha_3}$ represents $\{(\overline{OEEI_{2T}} - \overline{OEEI_{1T}}) - (\overline{OEEI_{2C}} - \overline{OEEI_{1C}})\}$ where the bar denotes average, the first subscript denotes the year, and the second subscript denotes the group.

Table 2 represents the regression results of the model. **From Table 2 it is clear that $\widehat{\alpha_3}$ i.e., the parameter estimate of D2DT is highly significant in the model. Thus, it can be stated that there has been improvement in online education during the concerned time periods for the treatment group.**

TABLE 2: Regression Results of the model represented by Equation (3)

Variables	Outcome Variable $OEEI_{it}$
Constant	.537*
D2	4.834E-02
DT	-5.723E-02*
D2DT	.312*
Adjusted R^2	.277

Note: * significant at 1% and 5% level

Access to online education definitely improved during the last one year (as far as my sample is concerned) but it was limited to students of urban and semi-urban areas. The

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students of the rural areas have been adversely affected due to closure of educational institutions. It is very unfortunate that these students have gained no knowledge but will become graduates. They have attended private tuitions (in some cases in my sample) and others have managed lecture notes from elsewhere to tide over the online examination. The online examination has proved to be a great threat to the future of the students of the urban areas particularly. With no proper knowledge base, the marks scored is abnormally high. The need and the urge to study has reduced drastically. Even though online education has improved for those who have access to internet facilities but the mode of examination has failed to maintain the standards of education. For the students of the rural areas also, the students have scored decent marks without having any knowledge about the subject. The online examination during the pandemic has not been effective at all.

Conclusion

A digital gap has been created among the students of urban and rural areas. Even though the students of urban and semi-urban areas have benefitted from online education due to systematic organisation of classes by many colleges during the course of the period, yet the students of the rural areas are deprived of such benefits. Many students in the urban areas were also disadvantaged due to lack of devices and internet facilities. Lack of basic infrastructure has led to such limitations. There should have been state intervention to overcome this problem to facilitate students have access to online education. But the indifferent attitude of the government has led to such digital divide. Initially it was a big challenge for many teachers because technology acted as a constraint for this mode of education but the teachers had to overcome this challenge by acquainting themselves with different e platforms to impart education. But the online mode of assessment failed to reflect the true picture in terms of assessment. The high scores obtained by the students have actually threatened their future as there is a lack of positive correlation between marks obtained and knowledge gained in many cases.

Suggestions

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- Intervention by the government to provide opportunities for online education to the students of the rural areas is urgently required to narrow down the digital divide.
- The nature of online examination should be revamped to assess the analytical skill, logical reasoning of students to lower the scope of open book examination and thereby widen the knowledge base.
- To motivate the students and help them develop interest, the curriculum should have been redesigned to help students break the monotonicity and explore their potential and capabilities.
- Assessing students on the basis of reviews of articles, writing research papers, writing articles and essays on topics related to the curriculum with certain modifications could have improved the methodology of assessment of students.

Limitations of the Study

The scope of my study is limited to a very few colleges of urban areas and semi urban areas of West Bengal where students from better-off families enrol themselves. Therefore, the efficacy of online education was significant for the treatment group. This efficacy was reflected in the data of those students who had access to internet facilities in the urban areas. Many colleges even in the urban and semi-urban areas failed to provide online education to the students due to non-availability of devices and internet facilities with the students. These types of colleges could not be included in my study because the survey was carried out using google forms and students of these colleges could not be included as these students did not have access to internet facilities. The students of the rural areas have been randomly selected from limited districts. With a better spread for the sample, the analysis could have been more robust.

References:

1. B. W., & Liedholm, C. E. (2002). Can web courses replace the classroom in principles of microeconomics? The American Economic Review, 92(2), 444–448-Analysis of the Empirical Literature. Review of Educational Research, 74(3), 379–439.
2. Basilaia, G., & Kvavadze, D. (2020). Transition to online education in schools during a SARS-CoV-2 coronavirus (COVID-19) pandemic in Georgia. Pedagogical Research, 5(4), 10.

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e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 9 Issue 10
October 2022

3. Bernard, R. M., Abrami, P. C., Lou, Y., Borokhovski, E., Wade, A., Wozney, L., Huang, B. (2004). How Does Distance Education Compare with Classroom Instruction? A Meta -Analysis of the Empirical Literature. Review of Educational Research, 74(3), 379–439
4. Blitz, C. L. (2013). Can Online Learning Communities Achieve the Goals of Traditional Professional Learning Communities? What the Literature Says. REL 2013-003. Regional Educational Laboratory Mid-Atlantic.
5. Bowen, W. G., & Ithaka, S. (2012). Interactive learning online at public universities: Evidence from randomized trials.
6. Clark, R. E. (1994). Media will never influence learning. Educational Technology Research and Development, 42(2), 21–29.
7. Deterding, S., Sicart, M., Nacke, L., O'Hara, K., & Dixon, D. (2011). Gamification. using game-design elements in non-gaming contexts. In PART 2———— Proceedings of the 2011 annual conference extended abstracts on Human factors in computing systems (pp. 2425–2428). ACM
8. Doucet, A., Netolicky, D., Timmers, K., & Tuscano, F. J. (2020). Thinking about pedagogy in an unfolding pandemic (An Independent Report on Approaches to Distance Learning during COVID-19 School Closure). Work of Education International and UNESCO.
9. Figlio, D. N., Rush, M., & Yin, L. (2010). Is it live or is it internet? Experimental estimates of the effects of online instruction on student learning. National Bureau of Economic Research
10. Harmon, O. R., & Lambrinos, J. (2006). Online Format vs. Live Mode of Instruction: Do Human Capital Differences or Differences in Returns to Human Capital Explain the Differences in Outcomes? Harmon, O. R., & Lambrinos, J. (2012). Testing the Effect of Hybrid Lecture Delivery on Learning Outcomes.
11. Hiltz, S. R., Coppola, N., Rotter, N., Toroff, M., & Benbunan-Fich, R. (2000). Measuring the Importance of Collaborative Learning for the Effectiveness of ALN: A Multi-Measure. In Learning Effectiveness and Faculty Satisfaction: Proceedings of the 1999 Sloan Summer Workshop on Asynchronous Learning Networks (Vol. 1, p. 101). Olin College-Sloan-C.
12. Maurin, E., & McNally, S. (2008). Vive la révolution! Long-term educational returns of 1968 to the angry students. Journal of Labor Economics, 26(1).
13. McCutcheon, K., Lohan, M., Traynor, M., & Martin, D. (2015). A systematic review evaluating the impact of online or blended learning vs. face-to-face learning of clinical skills in undergraduate nurse education. Journal of Advanced Nursing, 71(2), 255–270.
14. Murgatrotd, S. (2020, March). COVID-19 and Online learning, Alberta, Canada.
15. Navarro, P., & Shoemaker, J. (2000). Performance and perceptions of distance learners in cyberspace. American Journal of Distance Education, 14(2), 15–35
16. Petrie, C. (2020). Spotlight: Quality education for all during COVID-19 crisis (hundrED Research Report #01). United Nations.
17. Rovai, A. P., & Jordan, H. (2004). Blended Learning and Sense of Community: A Comparative Analysis with Traditional and Fully Online Graduate Courses. The International Review of Research in Open and Distance Learning, 5(2).
18. Sintema, E. J. (2020, April 7). Effect of COVID-19 on the performance of grade 12 students: Implications for STEM education. EURASIA Journal of Mathematics, Science and Technology Education, 16(7).

Received: *29 Sept. 2022*
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e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 9 Issue 10
October 2022

19. Tsai, F.-H., Tsai, C.-C., & Lin, K.-Y. (2015). The evaluation of different gaming modes and feedback types on game-based formative assessment in an online learning environment. Computers & Education, 81, 259–269
20. Wang, K. H., Wang, T. H., Wang, W.-L., & Huang, S. C. (2006). Learning styles and formative assessment strategy: enhancing student achievement in Web-based learning. Journal of Computer Assisted Learning, 22(3), 207–217
21. Xu, D., & Jaggars, S. (2013). Adaptability to online learning: Differences across types of students and academic subject areas.

Received: *29 Sept. 2022*
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