

ANALYZING DIGITAL DIVIDE AMONG UNIVERSITY STUDENTS OF PAKISTAN

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ABSTRACT

An emergency shift to online education after Covid-19 brought many challenges for students and teachers, especially the university students living in the rural areas of Pakistan. So this study has focused on assessing the problems students faced while acquiring online education with special reference to the theoretical background of digital divide. It is a quantitative study which employed Heckman's treatment effect model to analyze the impact of digital divide on university students' performance. The results of the study indicate that online education further increases an already existing digital divide between have and have nots. Online education is a good alternate of face-to-face education in many cases however for ensuring maximum benefits of online education requires proper availability of gadgets and internet access along with training. Existing online education system in developing countries like Pakistan may be more suitable to teach theoretical subjects like social sciences which are subjective in nature however it is not much appropriate for teaching numerical subjects. The findings of the study direct a positive impact of digital divide due to the scarcity of necessary gadgets, internet access, family income, gender, field of study, age and location.

Keywords: Digital divide, online education, socioeconomic status, have and have nots, rural, internet access.

INTRODUCTION

Sudden shift from face-to-face education to online education brought many challenges for the teachers and students in Pakistan as the Covid-19 changed the mode of education. Students observed many complications due to an abrupt shift to the technology mediated education (Piyatamrong et al., 2021). Students reported many difficulties in handling online education as they considered it a new experience for themselves yet the curriculum and infrastructure facilities were insufficient to align with online education. Problems of online education were not only limited to internet and technological access but the relevance of curriculum for this mode of education was also a major concern of the university students (Adnan, 2020). Teachers faced problems in handling students especially during exams. They were unable to keep a check and control unethical practices due to the lack of technological skills. They used other methods to control students like

reducing time and adding viva. Limiting time was a good option for the students to keep them busy with their own exams however students faced issues like insufficient time and disliked restrictions associated with online exams (Oliveira et al., 2021).

Students believe that teachers should bring variation and update to the latest gadgets, necessary for delivering online education. Research studies found students being disappointed due to the barriers of communication they faced in online education. However students and teachers both require training and skills to make best use of online education platforms (Piyatamrong et al., 2021). It has increased the importance of innovative teaching and learning methods. With the advancement of technology, new challenges and opportunities have emerged, now teachers will have to update themselves according the needs of virtual and online education (Gnanasegaran et al., 2021). Research found using social media for distance learning was more helpful for theoretical subjects. However for practical subjects students felt online education inefficient and less effective for their requirements (Nadeak, 2020).

H¹: Online teaching is more suitable to theoretical subjects than the practical subjects.

Urban and Rural Disparities

Gu (2021), maintain that students of rural areas and especially from low income families face difficulties in having a proper access to online education. Availability of gadgets like smartphones, computer and internet access facilitates technology mediated education. Online education is not an equal replacement of face to face education especially in developing countries like Pakistan where majority of the students face limitation of resources. They also reported difficulties like lack of interactions and absence of socialization which impeded group projects and class assignments (Adnan, 2020). School teachers suffered more due to the lack of institutional facilities and they are less skilled and technologically equipped as compared to the university teachers. Those who were living in rural areas of Pakistan faced connectivity issues as well as electricity disruption. Many of the teachers as well as students lacked ICTs for online education. Online education brought a new learning experience for students and teachers however workshops and trainings are necessary to develop skills in teachers and students (Noor et al., 2020). Research studies indicate that students of developed countries like Brunei are more satisfied with internet and technological access as compared to the students of developing countries like Pakistan because the developed countries has more urban population (Qazi et al., 2020). In comparison to Pakistan, Brunei has only 21.75% rural population whereas Pakistan has 62.84% rural population (*Brunei: Share of Rural Population 2020 | Statista*, n.d.; *Pakistan - Rural Population - 2022 Data 2023 Forecast 1960-2020 Historical*, n.d.). Keeping in view the potential and necessity of online education it cannot be denied anymore. To cater the future needs of mediated learning, policymakers will have to update education system which is efficient and standardized (Mumtaz et al., 2021).

H²: Rural students faced more problems during online education than the urban students.

Training of Online Education

The students of virtual university consider online education as an opportunity to be more skillful in using ICTs and related software like Microsoft Word, Excel and Power Point. Using PC for chat and videoconferencing with instructor and solving different task help them in improving their skills related to information technology. They found it helpful and motivating, creative and adaptable for learning. Many of the students are confident to get good jobs after getting online education and they also view it as an added advantage to teach others online if they are to opt teaching as profession. A well designed online education system is necessary and there should be more budget and trainings to ensure smooth working of e-learning because this system is not only indispensable today but also innovative and facilitating in learning (Akhter, H., & Mahmood, 2018). There is a significant awareness related to e-learning and now teachers and students are motivated enough to adapt it. Educational institution and government should make a coordinated effort to facilitate and promote mediated education (Qureshi et al., 2012). There are mix kind of responses especially by medical students who consider online learning an easy alternative during Covid-19 (Mukhtar

et al., 2020). However they show more inclination and ease in face to face learning (Abbasi et al., 2020). In Pakistan, e-learning is beneficial and affordable for the students studying at Allama Iqbal Open University (AIOU), providing a distance learning system of education (S. B. Khan & Jumani, 2012). Keeping in view large population of Pakistan which is more than 200 million, the country has a greater need of distance learning universities like AIOU and Virtual University. Similarly, all universities should be upgraded with latest e-learning technology, trainings and infrastructure (Shahzad, 2017).

There is positive as well as negative effects of online education. One positive effect is that the students receive greater guidance from teachers in the form of synchronous or asynchronous communication. Whereas on the other hand, teachers and students lack face to face interaction, which is necessary for a teacher to assess real time feedback of students and their involvement in the learning process. This challenge has also brought many opportunities for teachers and students like now they have started benefiting from the technological purposes for education like arranging webinar and connecting institutions around the globe (Oliveira et al., 2021).

With the shift to online teaching, it was considered essential and the only way to teach, communicate and collaborate with students. Results of different studies state that teachers should try different teaching methods to overcome the barriers of virtual learning. The discipline is also decisive in effectiveness of technology-mediated teaching. For example the students of music and arts found online teaching less useful as compared to the students of information sciences (Vladova et al., 2021). Using of multiple online platforms by different teachers actually confused students to follow separate instructions from all teachers. It enhanced the realization of using a uniform platform for online teaching which would facilitate both students and teachers. Smooth connectivity of internet also interrupted lectures at both end especially student from different areas reported problems. Technology helped students by offering group discussions and at least provided an alternative for higher education to secure the precious lives and time (Oliveira et al., 2021).

Purpose of the Study

The purpose of study is to explore the problems related online education particularly faced by the lower socioeconomic groups of society mainly living in rural areas of Pakistan.

THEORETICAL FRAMEWORK

Knowledge gap theory and digital divide support theoretical foundations of this study. Tichenor, Donehoue and Olien (1970, as cited in Gaziano, 2016) stated that the population of higher socioeconomic status acquire knowledge or information faster as compared to the population of lower socioeconomic status. In other words, the privileged class has more access to knowledge as compared to the less privileged class. Topcu (2022), writes in this technological advancement world where access to information does not require much effort. Anyone can access to the desired information just by a single click however it is interesting to study knowledge gap hypothesis after the increased connectivity. The results of online and social media use cannot be uniform because the individuals differ in characteristics like educational background, socioeconomic status and their cognizance regarding digital media. Tsetsi & Rains (2017) investigated the knowledge gap hypotheses keeping in view different demographic groups. They mainly studied how the use of internet and smartphones contributed to the inequality of haves and have nots among the users of different socioeconomic status.

Digital divide research mainly focuses on the different demographic variables like socioeconomic status, including income, age, gender, education as well as urban or rural location (Azubuike et al., 2021). Digital divide creates problems for those having limited or lack of internet access whereas during Covid-19 urban population particularly had to ensure online activities with inadequate internet access while meeting emergency crisis (Lai & Widmar, 2021). Studying different variables with reference to Covid-19 knowledge gap, Wang et al., (2021) stated that educational level is a decisive factor in determining knowledge gap. Digital divide is obvious because internet use increased the already existing knowledge gap. Traditional media and interpersonal communication are not effective in improving knowledge level. Access to online information is not the only reason of knowledge inequality rather in some cases the quality of use, also reflect the differing benefits individuals acquire through digital media (Li & Cho, 2021). (Mathrani et al., 2021) measured digital

divide with the help of variables like gender, age, family income and their level of study. Digital divide still prevails particularly in developing countries especially gender and lower socioeconomic groups. Access to technology and internet is associated with first level of digital access (Mathrani et al., 2021; Rotondi et al., 2020). This study has been conducted on university students of Pakistan mainly focusing on first level of digital access because contrary to schools and colleges, mainly the universities switched to online education. Considering the theoretical underpinnings of knowledge gap and digital divide the variables of the study are mainly linked with the concept of have and have nots. This study not only highlights the barriers of effective online education in developing countries like Pakistan but also provide empirical evidence regarding the importance of providing required gadgets and internet connections in the rural areas to overcome different levels of digital divide otherwise unprivileged population will lag behind in knowledge and skills.

RESEARCH METHODOLOGY

This is a quantitative research study which used online surveys based on structured questionnaire. To measure the impact of digital divide this study employed Heckman Treatment effect model of regression, particularly designed for such type studies in which the impact of digital divide is measured while assuming that the digital divide is function of some other observable factors such as availability of internet, possibility of possession of computers and electricity etc. Questionnaires consisted of descriptive portion as well as nominal scale on possession of computer/laptops, internet etc. Due to time and monetary constraints the population of this study was federal capital Islamabad. Moreover it was observed that Islamabad is a city where students from all provinces of Pakistan, come to get education so to provide a full spectrum of characteristics of all respondents, educational institutions of Islamabad were chosen.

Students were asked questions about their accommodation place whether it was urban or rural and field of study (Engineering, arts, social or management science). Other questions were related to gender, income, internet and technological access and home environment, as well as experience of online education in comparison to face to face education. Some questions were open ended questions asking students' satisfaction regarding results of online education as well as comparison of online education versus face to face education. To answer these questions students were provided the chance of positive or negative responses. Students' identity and answers were kept confidential. Mathrani et al. (2021) studied similar kind of variables in a study to analyze digital divide of developing countries during online education. This study has adopted above mentioned variables suggested by the relevant literature.

Sampling

An online survey was used to collect data from students of federal capital Islamabad, Pakistan who experience online education during 2020 and 2021 through structured questionnaire by applying convenient sampling. Convenient sampling was only way through which survey could be conducted because whole population cannot be accessed at a time of survey for random sampling Required sample size was measured as 384, using Cochran (1973) who developed a formula to calculate a representative sample for proportions of unknown population as:

$$n_0 = \frac{z^2 pq}{e^2}$$

where, n_0 is the sample size, z is the selected critical value of desired confidence level, p is the estimated proportion of an attribute that is present in the population, $q = 1-p$ and e is the desired level of precision. For several factors, a sample of 486 respondents was eventually accessed, which was 26 percent greater than the required sample. For instance, having a bigger sample size increased confidence that sample responses do not differ considerably from real opinions. Oversampling helped guarantee that the required sample size of 385 people was met.

To study the association between different variables and their contribution to digital divide and student's performance, this study has employed Heckmen's model.

Model Specification

Concept of digital divide can well be estimated by using Heckman's model given below:

Selection Equation

The Heckman's model has two equations: selection equation and outcome equation, with the selection equation capturing the selection bias and the result equation capturing the specification of interest. In the selection equation, digital divide is used as a dependent variable. The Probit model for sample selection equation, like the Heckman model, is estimated to include unobservable factors. The inverse mills ratio (λ) is used to detect selection bias, and it automatically enters as an independent variable in the result equation. One of the main advantages of utilising the Treatment Effect model over the Heckman's approach is that it is better. It's also worth noting that the Treatment Effect model takes into account both the treatment effect value and the selection bias. Sample selection equation can be written as follows:

$$d_i = x_i\alpha + \mu_i$$

Where $d_i > 0$ and 0 otherwise

$$\text{Prob}(d_i=1 | x_i) = \Phi(x_i\alpha) \text{ and}$$

$$\text{Prob}(d_i=0 | x_i) = \Phi(x_i\alpha)$$

The dependent variable is in binary form as respondents who belong to urban area, get value 1 (Urban=1) otherwise zero and d_i could be estimated when $d_i = 1$ if $d_i > 0$ and for $d_i = 0$ otherwise.

This is explained in terms of conditionality of students' performance due to digital divide. The vector of explanatory variable which includes education, age etc. represented by x_i . In addition, α is a vector of coefficients, and μ_i is the error term. Given selection bias and the fact that 'd' is an endogenous variable, the assessment objective is to estimate the regression model using the observed variables. The lambda β or inverse mills ratio, which measures selection bias, is determined as follows:

$$\lambda = (x_i/1 - (x_i \alpha))$$

Here, Φ is a density function and α shows the normal distribution.

Outcome Equation

Outcome equation, carrying the variable of interest or policy as dependent variable, can be written as follows:

$$z_i = y_i\beta + d\alpha + \varepsilon_i$$

Where z_i signifies the vector of possible mediators, such as age, and y_i denotes the students' performance throughout online instruction. β is a collection of parameters, and d is a digital divide dummy variable that comes straight from the selection equation and is known as the treatment effect score in the outcome equation. It provides a counterfactual analysis as well as substantial differences between treated and non-treated homes. The error component of the outcome equation is represented by the letter ε_i . The following are the most important variables:

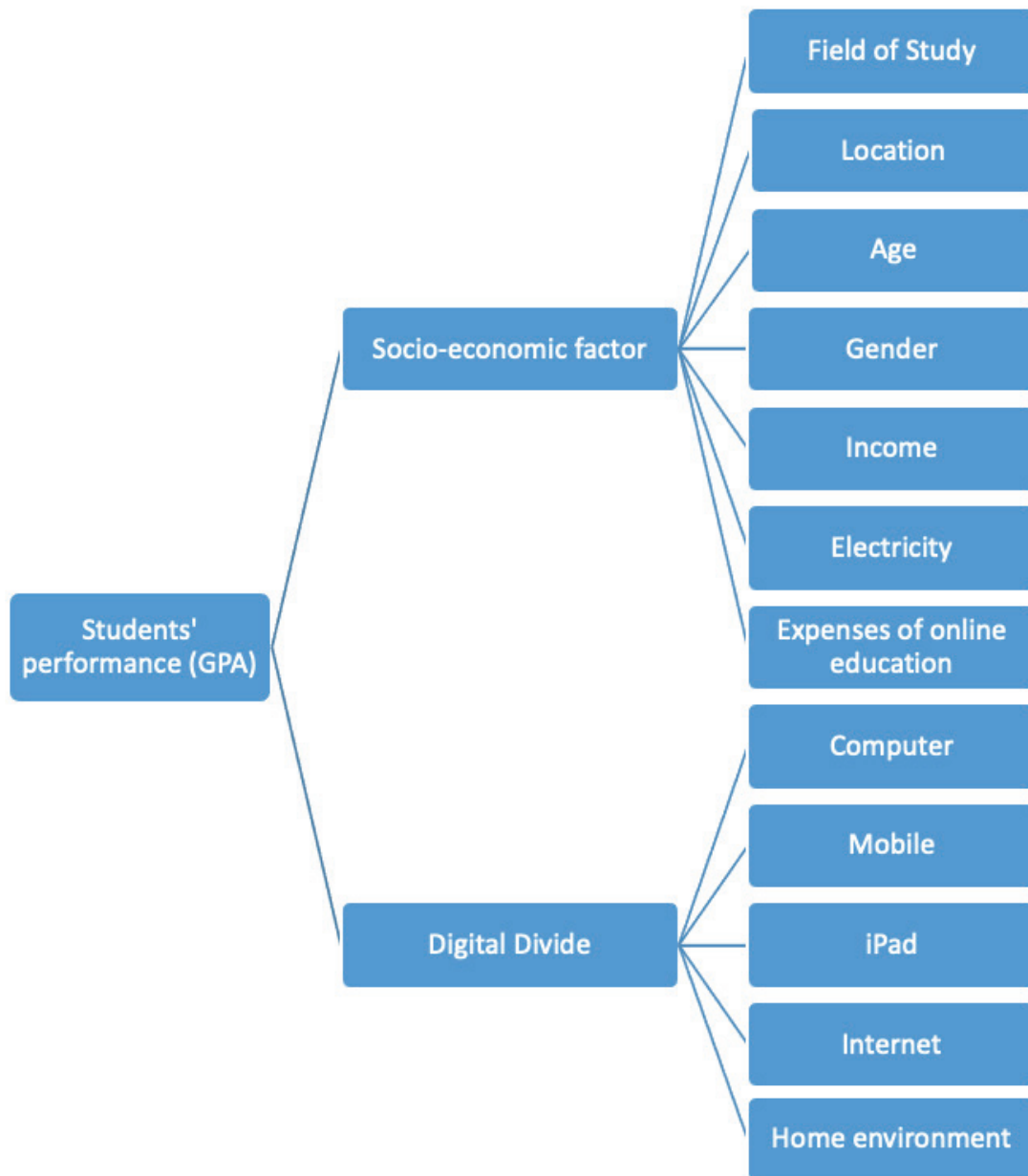


Figure 1. Variables of digital divide along with their relationship with students' performance

RESULTS

Heckman's treatment effect model has been used to analyze the impact of digital divide on university students' performance.

Table 1. Descriptive statistics of sample respondents

Variable	Mean	Std. Dev.	Min	Max
Age	22.023	3.55	16	46
Income	111316.9	39912.2	50000	600,000
GPA	3.16	0.526	1.75	4.7
Gender	0.67	0.46	0	1

Table 1 reflects descriptive statistics of sample respondents. The mean of age remained 22.023 for which minimum age was 16 years and maximum age of respondent was 46 years. Income mean is 111316.9, minimum income has been recorded 50000 and maximum income is 600,000. The mean of GPA is 3.16 whereas minimum reported GPA is 1.75 and maximum GPA is 4.7%. Gender is a dummy variable which was coded with 1 for male and 0 for female; the mean is 0.67 which indicate the distribution of respondents was 67% and 33% for male and female respectively. Usually, ratio of male student is more than female students in Pakistani universities that's why mean value is closer to 1.

A significant inverse mills ratio of -0.24 in model indicated the existence of selection bias. Computer, mobile, iPad, availability of internet and home environment are found to be the reason for digital divide. Different variables have been employed to assess the phenomenon of digital divide, which university students faced during online education in Covid-19. The results show that most of the explanatory independent variables have a positive impact on digital divide, such as field of study, location, age, gender, family income, expenses of online education and digital divide, computer, mobile, iPad and Internet. Whereas, electricity and home environment reflected insignificance to digital divide. Results in Table 2 reflect that H¹ & H² have been approved significantly. P value for H¹ is 0.000 which shows strong significance for the hypothesis that online education is more suitable to theoretical subjects than the practical subjects. Similarly, P value for second hypothesis is 0.000 which is too highly significant indicating rural population face more digital divide than the urban population.

Table 2. Heckman's treatment effect model results

Number of obs = 486						
Wald chi2(4) = 57.55		Prob > chi2 = 0.0000				
Censored obs = 155		Uncensored obs = 331				
Adaptation	Outcome Eq.			Selection Eq.		
	Coef.	Z	P>z	Coef.	Z	P>z
Field of Study	-0.096	-3.88	0.000***			
Location	0.006	0.67	0.502			
Age	0.017	2.36	0.018**			
Gender	-0.254	-4.77	0.000***			
Income	0.016	3.22	0.001***			
Electricity	0.007	0.13	0.899			
Expenses of online education	-0.12	-2.25	0.025***			
Cons.	10.122	4.90	0.000***			
Digital Divide	0.185	3.76	0.000***			
Computer				-0.41	-2.65	0.000***
Mobile				-1.39	-6.06	0.000***
iPad				-0.52	-2.41	0.016*
Internet				0.915	5.65	0.000***
Home Environment				0.164	1.04	0.297
Inverse mills ratio				Rho		0.525
lambda	-0.24	-3.06	0.002***	Sigma		0.471

Asterisks ***, **, * indicate 1%, 5% and 10% level of significance respectively.

Source: Authors' own calculations

DISCUSSION

With the emergence of Covid-19 most of the universities in the world shifted from face-to-face education to online education, similarly Pakistani universities adopted online education system. Based on the above results the study reflects difference in digital access for urban and rural students. University students reported differing experiences of online education based on their demographics and socioeconomic conditions

(Rotondi et al., 2020). For examples students residing in urban areas faced fewer barriers during online education as compared to the rural students. Similarly, students of lower socioeconomic groups faced limitation of facilities, as availability of modern technologies (laptop, smartphones, iPad) and internet access. Some other interesting revelations are the varying experience of students belonging to different disciplines. Students of social studies reported satisfactory learning experience through online education as compared to the students of management sciences or engineering students (Azionya & Nhedzi, 2021).

Let's first explain the results of outcome equation of the Heckman's model. According to the results in above table, field of study played a significant and negative role in determining outcome of students' performance. It means that students whose field of study was theoretical in nature benefited (got high score) from online education and other could not get real benefit (low score) from online education. Social studies had a scale of 1, Arts & Humanities had a scale of 2, engineering & IT had a scale of 3 and Management sciences had scale of 4. Moreover, demographic location is found to be insignificant in determining students' performance.

Age of respondents showed positive and significant relation with students' GPA, which is in line with the study of Tsetsi & Rains (2017). Gender had a negative and highly significant coefficient, which means that male (with score 1) is likely to attain less GPA as compared to female students. Income of the respondents' family is found to be significantly determining students' performance, hence with high income, students are likely to perform well, as higher income group has more resources and assets to buy electronic gadgets (i.e. computer, mobile, iPad and accessibility of internet). Variable of electricity is found to be insignificant. Higher expenses of online education is found to be negatively impacting students' performance due to the fact that lower income group was unable to arrange such electronic gadgets during online education (Esteban Jr. & Cruz, 2021).

On the other hand, selection equation was based on the assumption that digital divide also influences students' performance, and the digital divide is function of availability of electronic gadgets (i.e., computer, mobile, iPad and access to internet) as well as the home environment during online education. Variable of computer/laptop is negative and significant presuming that availability of computer/laptop was likely to reduce digital divide. Similarly, iPad and mobile are also significant and negatively impacting digital divide as availability of these electronic gadgets was likely to reduce digital divide. Access to broadband internet is also significant and impacting positively of students' performance during online education (Mohammad et al., 2021).

CONCLUSION

Findings of the study indicate that the digital divide has a positive impact on student's educational performance during online education. Significant digital divide has been reported by measuring access to internet, smartphone, laptop, iPad and other contributing factors like family income, home environment, gender, and field of study, age, electricity and home environment. Results indicated online education is suitable to theoretical subject and students living in urban areas, having more and easy access to gadgets and internet. Similarly, students reported less satisfaction to online education and its results. So we can conclude a significant rural digital divide especially for the low income families along with many other contributing variables all mentioned in discussion.

LIMITATIONS & RECOMMENDATIONS

Fewer studies have been conducted on digital divide particularly in developing countries keeping in view the context of online education experience of students in Covid-19. So after studying relevant literature a few variables have been studied in this study. Secondly, this study has been more focused on assessing the first level of digital divide. The future studies can be conducted on analyzing the second and third level of digital divide. The second level of digital divide deals with inequalities of technical skills whereas third level of digital divide focuses on benefits inequalities for all the users of internet and digital media (Lythreatis et al., 2022).

In order to bridge digital divide the higher education commission should provide free laptop and scholarships to the needy students especially living in the rural areas of Pakistan (B. U. Khan et al., 2020). Jamil (2021) suggests that there should be allocation of funds along with an integrated effort by federal

and provincial governments to enhance technological access to the less privileged individuals of the society. Higher education should especially focus on students and teachers of rural areas by providing them necessary trainings, accessibility of technology and connectivity particularly residing in far-off areas having lower family income (Jamil, 2021). The study also suggests to pay special attention on digital access and trainings of female as they still have less opportunities as compared to men in Pakistan.

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