TOWARDS DEVELOPMENT VIA EDUCATION: ROLE OF TECHNOLOGY

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Abstract. Technology has been gaining popularity in many fields of life and its importance can be seen to increasing with the passage of time. Technology has also many implications in education related fields and there are several aspects that may increase the quality of education. This study has been conducted in order to study the impact of such aspects such as internet access, internet users and mobile coverage on quality of education along with two control variables, population growth and literacy rate. Data was collected for 30 years from Asian countries and was tested and scrutinized and results were obtained. The tests that were used in this study include unit root test, PCSE and GMM estimation tests. The results of these tests indicate that all the independent variables i.e. internet access, internet users and mobile coverage have significant impact on quality of education but the control variables i.e. population growth and literacy rate have no significant impact on quality of education. In the last portion of the study, the author has mentioned some implications and benefits in theoretical, practical and policy making context. In addition, the author has also mentioned some limitations of the study and some recommendations that can be used to improve them.

Keywords: development; education; quality of education; internet access; internet users; mobile coverage; Asia


JEL Codes: O1, O35

1. Introduction

Internet is one of the most important innovations in the world of information technology (IT) (Saengchai & Jermsittiparsert, 2019; Usak, Kubiatko, Shabbir, Dudnik, Jermsittiparsert, & Rajabion, 2019). With the help of internet, the vast world has been narrowed down to a sophisticated global village (Montrieux, Vanderlinde, Schellens, & De Marez, 2015; Ragulina, Semenova, Zueva, Kletskova, Belkina, 2018). A key role is played by internet in the field of education, especially in Asian countries. In the academic community, a profound transformation has been undergone during recent years, assuming some new dimensions affected through technology-driven applications (Abdel-Basset, Manogaran, Mohamed, & Rushdy, 2019). Over the last two decades, the use of internet has increased to a great extent. In Asian countries, more than 80% students are engaged in using internet for different purposes, especially for the purpose of getting some information related to their education (S. A. Asongu & Odhiambo, 2019). In the Asian context, internet is increasingly penetrating in to the field of education. A number of initiatives are being undertaken by the Ministry of Education as well as international donor agencies, for the purpose of improving the quality of education (Reid, 2018). Technology has been introduced to a great extent in teaching field. Most of educational institutions in Asian countries have replaced books and printed sources of information with electronic resources. Internet is used in the form of academic tool (Pucciarelli & Kaplan, 2016).
So, it has become highly important for academic researchers to deeply analyse that how internet is playing its role in influencing quality of education within Asian context (Celebi, 2019). It has been found by some researchers that academic performance of students gets elevated through the use of internet, however, some found that internet has an adverse impact on academic performance (Selwyn, 2016; Skryabin, Zhang, Liu, & Zhang, 2015; Tondeur, Forkosh-Baruch, Prestridge, Albion, & Edirisinghe, 2016; Wiley & Green, 2016). However, very few studies have been conducted for understanding the key role played by technical support in the field of education. So, the focus of current study is on filling this gap.

Above mentioned figurec1 showing the ratio of internet users in Asia from 2015 to 2019. In most of Asian countries, the provision of updated literate materials, journals, required resources as well as modern books have got negatively affected, due to lack of availability of required funds to run universities effectively. The quality of education in Asian countries has got adversely affected due to the economic recession, devaluation of currency and global political crises. Due to such types of issues, the management of most of education institutions are not giving much importance to quality of education. Technological support is something which needs to be considered highly in order to improve quality of education. Previously, there have been some studies to analyse the impact of technological support on quality of education, but there has been no study conducted within Asian context (Comi, Argentin, Gui, Origo, & Pagani, 2017; Englund, Olofsson, & Price, 2017). Moreover, none of previous studies have focused on examining the impact of internet access, internet users and mobile coverage on quality of education within Asian context. Hence, the current study has been carried out to deeply analyse that how technological support can prove to be a key factor in improving quality of education.

In order to achieve this specific aim of study, following research objectives have been identified;

- To analyse the impact of internet access on quality of education in Asian countries.
- To study the impact of internet users on quality of education in Asian countries.
- To examine the effect of mobile coverage on quality of education in Asian countries.

The findings of this study prove to be highly beneficial for the management of most of Asian educational institutions, because, they can get an understanding about how technical support must be focused in order to improve quality of education. Moreover, the findings of study are also beneficial for teachers who are key to support students for their academic outcomes (c.f., Ahmed, Umran, Qureshi & Samad, 2018). Teachers are the one who are involved
in providing education to students, as they can get to know that whether or not internet should be used for providing education to their students. Along with this, the current research study proves to be helpful in adding value to the literature, especially within the field of education.

The dissertation is divided into five important parts. The first part is introduction, next part is literature review, which includes critical analysis of various studies conducted related to the research issue. The third chapter of dissertation is research methodology and after this analysis of data collected during the study is done. The last chapter of this dissertation is conclusion and recommendations.

2. Literature Review

2.1 Internet Access and Quality of Education

Education has direct impact on economic development (e.g. Prakash, Garg, 2019; Baltgailis, 2019). Internet is considered as a priceless source of information for students as well as for teachers and this serves as a tool for enhancing overall productivity within the field of education. With the help of internet, a number of powerful tools are made available, which can assist in transformation of current isolated teacher-centered as well as classrooms which are bound to text-books, in to students’ focused, and highly interactive learning environment (Mtebe, 2015). Internet refers to a ‘sea of information’, which can be used by students and teachers for getting a wide range of information. The use of internet has become highly trendy especially in Asian countries. People of all ages are highly engaged in using internet for the exchange of information and also for the purpose of networking (Ololube, 2015). Nowadays, most people in Asian countries have access to internet. As a result of having availability of smart phones, most of people have access to internet (Briz-Ponce, Pereira, Carvalho, Juanes-Méndez, & García-Peñalvo, 2017). Bulman and Fairlie (2016) carried out a research and found that those people feel ease in getting information related to any topic who have access to internet. The access to internet makes students comfortable in searching for any type of information and this helps them in giving their best in studies. Even though, the focus of this study was on examining the importance of access to internet for students, but the research study did not focus on analysing the impact of internet access on quality of education. Hence, the current study has been carried out to fill this gap and the focus of current study is on examining that how access to internet can influence quality of education. Moreover, a study was conducted by Comi et al. (2017) and they found that now mostly students and researchers ensure proper access to internet. Internet is something which is considered as highly important especially by most of researchers. When students as well as researchers have to face issue of inadequate and outdated materials in books and printed sources, then they prefer to get access to internet in order to get completely updated data. It means, the study has revealed that access to internet helps in getting latest data and collecting latest information, which helps students in improving their knowledge about some specific topic or issue (S. Asongu & Asongu, 2018; Dinç Aydemir & Aren, 2017; Gong & Yi, 2018). This research focused on understanding the impact of internet access to the students and researchers’ ability of collected latest information. This research study was carried out within Chinese context, hence, the current study has been carried out in Asian context in order to fill the gap. Domingo and Garganté (2016) carried out a study and revealed that when people have access to internet, then they use internet as a source of improving education. Internet access to both students and teachers prove to be highly beneficial for improving overall quality of education. When internet is accessed in educational institutions like schools, colleges and universities, then this actually results in improving education’s quality. On the basis of these findings, following hypothesis has been developed;

H1: Internet access has a significant impact on quality of education in Asian countries.
2.2 Internet Users and Quality of Education

Englund et al. (2017) found that there is a strong relationship between use of internet and overall measure of engagement level of students. Those students who study in best wired campuses are more participative in practices of active learning, as compared to those, who do not study in best wired campuses. The information technology is positively relevant to engagement in educational practices. When internet is used within educational institutions both by students and teachers, then this results in enhancing the engagement level of users. Although the study focused on examining the impact of internet users on their level of engagement, the research study did not analyse the relationship between internet users and quality of education. So, the current study has been carried out to fill this gap. Moreover, Gul et al. (2017) conducted a research for understanding the impact of internet users on quality of education in China. As per findings of this study, it has been revealed that when internet is used in any educational institution, then this ultimately results in enhancing quality of education (Rai, Dua, & Yadav, 2019; Tight, 2019; Topa, Moriano, & Moreno, 2012). In order to ensure high quality education in any institution, it is highly important to ensure availability of proper technical support for students, teachers as well as management in institution. Technical support in terms of using internet is highly important for enhancing quality of education (Kentnor, 2015). Even though, this research study examined the impact of internet users on quality of education, but this study was carried out in Chinese context. As per the need and increased importance of internet for Asian countries, the focus of current study is on examining the impact of internet users on quality of education. This study has helped in filling the gap in literature, through understanding the relationship between internet users and quality of education (Mahrinasari, M. S., Haseeb, M., & Ammar, J. (2019). On the basis of this, following hypothesis is developed;

\[ H2: \text{There is a significant relationship between internet users and quality of education in Asia.} \]

2.3 Mobile Coverage and Quality of Education

Mobile phones have become the most important part in people’s daily lives. Mobile phones are considered to be the most important source of communicating with each other and it has a virtual impact on business as well as social activities (Lai, 2015). Lonsdale et al. (2019) found that mobile coverage helps in promoting collaborative as well as various types of learning with the help of wireless connection to the internet. It is quite useful to adopt mobile coverage in learning processes through the higher institution management. Mobile coverage is helpful for students to get motivated and engaged within the classrooms. Along with this, mobile coverage is useful to promote learner-centered participation. Moreover, McKnight et al. (2016) argued that mobile coverage is important for collaboration between students and teachers, which ultimately helps in enhancing quality of education. Besides this, mobile coverage within classrooms is important to retrieve important information. This research study has focused on understanding the importance of mobile coverage for education’s quality, but the study has not been conducted in Asian context. Hence, the current study has been carried out to fill this gap. On the basis of this, following hypothesis is developed;

\[ H3: \text{There is a significant relationship between mobile coverage and quality of education in Asia.} \]

3. Methodology
3.1 Data

The basic variables which are under consideration in this particular study include internet access, internet users, mobile coverage and quality education. Apart from these variables, two control variables i.e. population growth and literacy rate have also been included in the study. Data collection is a very significant process and its authenticity results in the accurate outcomes in the form of results. Therefore, data has been gathered from reliable source of
World Bank Indicators by World Bank for the period of 30 years. Some of the countries of Asian region have been selected for data collection process.

### 3.2 Model Specification

Data collection procedure leads towards the designation of measurement units to each of the variables that have been put under consideration in this particular study. In this regard, internet access IA is an independent variable and has been measured in terms of the number of people having access to internet facility. In the same way, internet user’s IU have also been measured in terms of the percentage of peoples using this innovative facility. Mobile coverage MC has been measured in terms of the number of people having access to mobile phones. The measurement unit of the dependent variable, quality of education QE is the level of satisfaction level of students. After independent and dependent variables, the control variable population growth PG has been measured in terms of the number of people in the country while the other control variable, literacy rate LR has been measured in terms of the number of educated people in the country. Based on these notations and measurement units, the author has generated the following regression equation:

\[
Q_{Eit} = \alpha + \beta_1 IA_{it} + \beta_2 IU_{it} + \beta_3 MC_{it} + \beta_4 PG_{it} + \beta_5 LR_{it} + \varepsilon_{it}
\]

In the above equation, quality of education has been represented by QE, internet access has been represented by IA, internet users have been represented by IU, mobile coverage has been donated by MC, population growth has been shown by PG and literacy rate has been represented by LR. While, \(\varepsilon_{it}\) is the term that is used to represent error.

### 3.3 Estimation Methods

#### 3.3.1 Panel Unit Root Test

Unit root tests are used for the core purpose of exploring and studying the order of integration of the variables of the study as well as to investigate their stochastic properties. From the two most commonly used unit root tests i.e. LLC and IPS, the author has employed LLC unit root test for this particular study. It must be noted here that these tests are actually derived from augmented Dickey Fuller unit root tests and are actually developed in order to solve the size and power related issues of the traditional tests of unit root (Pesaran, 2004). The difference between these two tests is that LLC unit root test shows same autoregressive process while IPS unit root test shows heterogeneous autoregressive process. These tests are applied in level as well as first difference series and the results of both the series are effectively compared. Studies have clearly shown that the unit root tests involve null and alternate hypothesis where null hypothesis suggests the presence of unit root and non-stationary state of data while alternate hypothesis suggests the absence of unit root and stationary state of the collected data. Based on these properties of these hypotheses, the results of unit root tests are evaluated and interpreted accordingly. As the author has used LLC unit root test, its general equation is given as:

\[
\Delta y_{it} = a_i + \rho y_{i,t-1} + \sum_{j=1}^{p_i} a_j \Delta y_{i,t-j} + \varepsilon_{it}
\]

Here \(\Delta y_{it}\) is the difference that \(\Delta y_{i,t}\) shows for \(i^{th}\) country for the specific time period of \(t\).

#### 3.3.2 GMM and PCSE Approaches

The following general equation for the estimation of the variables can be used:

\[
Q_{Eit} = \alpha + \sum_{j=1}^{7} B_{j} X_{it} + \sum_{j=1}^{4} \delta_{j} CEF_{dumj} + \sum_{j=1}^{30} \theta_{j} Y_{j} + \varepsilon_{it}
\]
In this equation, $\alpha$ is the constant value, $I$ represents the country, $t$ represents the time or year, $X_{it}$ shows the explanatory variable, $B_j$ is its coefficient, $CEF_{dum_j}$ shows the country fixed effect dummy and $\delta_j$ is its coefficient. One of the benefits of use of time fixed effect dummy is that it reduces the cross-country regression through the usage of time series and aggregate trends. Another benefit of time fixed effect dummy is that it can explore the structural break, if it is present in the collected data. While studying panel data approach, usually the following tests are used for various purposes: autocorrelation test in order to find any correlation among the variables, heteroscedasticity test in order find out whether the variables are heteroscedastic or not, cross sectional dependence test in order to find out the dependency of the variables in context of cross section, and multicollinearity test in order to find out any multicollinearity relationship between the variables. The main benefit to use these tests is that it will provide and accurate results of the study. These tests are very important as without using these tests, the authentic results are very difficult to obtain, and it will also be difficult to decide what tests must be applied further on the same data. All the above mentioned aspects relate the importance of these tests in the current study (Blundell & Bond, 1998). The results of all these tests have been presented in the table 1 of the study. This table clearly indicates the fact that there is significant heteroscedasticity as well as cross sectional dependence between the variables. In addition, these results also indicate that there is no autocorrelation and multicollinearity among the collected data. The detailed results can be viewed in the table 1 below:

<table>
<thead>
<tr>
<th>Table 1. Diagnosis Checks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heteroskedasticity</td>
</tr>
<tr>
<td>Autocorrelation</td>
</tr>
<tr>
<td>CD dependence</td>
</tr>
<tr>
<td>Multicollinearity</td>
</tr>
</tbody>
</table>

After these tests, correlation test was also used by the author. The results of this test have been presented effectively in table 2. These results indicate that no significant correlation bias has been found in the collected data. In addition to this, these results also show the relationships between the variables involved in this study (table 2).

<table>
<thead>
<tr>
<th>Table 2. Correlation Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
</tr>
<tr>
<td>IA</td>
</tr>
<tr>
<td>IU</td>
</tr>
<tr>
<td>MC</td>
</tr>
<tr>
<td>PG</td>
</tr>
<tr>
<td>LR</td>
</tr>
<tr>
<td>QE</td>
</tr>
</tbody>
</table>

As the above-mentioned tests and their results indicate the fact that there is significant heteroscedasticity as well as cross sectional dependence in the collected data, these aspects are considered as issues that may cause inaccurate results. Therefore, some approach must be used in order to resolve these issues and problems. The author has selected two most important tests in this regard i.e. PCSE and GMM estimation techniques. By using these techniques, the results that are obtained are very accurate and authentic. It must be noted here that country fixed effect as well as time fixed effect have been used in this study for various purposes. Let us discuss PCSE test first.
An assumption about this test is considered that is there is by default presence of disturbances and variations in the results and these variations are actually containing heteroscedasticity and correlations. In addition to PCSE, another test that is used by the author in this study is GMM estimation test (Arellano & Bover, 1995). This test involves the fact that lagged values of estimators can effectively deal with endogeneity related problems. An important point that must be discussed here is that there are two distinct types of GMM test used generally i.e. first differenced and system GMM. The drawback of first differenced GMM method is that it does not provide accurate results if the sample size of the data is very small. On the other hand, system GMM has benefit that its results are very authentic and accurate, and this happens because this method involves a large number of instruments. Another property of system GMM is that it joins two regressions i.e. level regression and first difference regression. Based on these benefits, it is observed that the model also has enhanced precision and can reduce small sized sample bias. GGM estimation technique may be used in accordance with the following equation:

$$\vartheta_{it} = \alpha_i + \gamma \vartheta_{it-1} + \sum_{p=1}^{p} \beta_p Z_{it}^p + \sum_{q=1}^{q} \beta_q Z_{it}^q + \sum_{r=1}^{r} \beta_r Z_{it}^r + \epsilon_{it}$$

### 4. Empirical Results

#### 4.1 Results of Unit Root Test

As discussed in the earlier section, the unit root tests are used in order to explore the stationary or non-stationary states of the collected data, the results of LLC unit root test have been presented in the table 3. It can be viewed in the table that different values for level as well as first difference series have been given. The values reject or accept the null hypothesis in accordance with different significance levels. First of all, when the level series of the table is observed, it can be seen that all the variables have rejected the null hypothesis, but mobile coverage has not rejected the null hypothesis. This result suggests that unit root is not found in this series and the data is considered to be stationary. When the data was first differenced, again all the variables have rejected the null hypothesis and the significance level of this rejection is increased in this particular series. Again, in this case, the unit root is not found while the data still remains stationary. These results can be concluded by stating that the data in both level and first difference series is stationary due to the absence of unit root (table 3).

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Level</th>
<th>1st difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>-5.633*</td>
<td>-12.874***</td>
</tr>
<tr>
<td>IU</td>
<td>-5.983*</td>
<td>-10.075***</td>
</tr>
<tr>
<td>MC</td>
<td>-3.359</td>
<td>-14.976***</td>
</tr>
<tr>
<td>PG</td>
<td>-5.237*</td>
<td>-9.085***</td>
</tr>
<tr>
<td>LR</td>
<td>-2.483*</td>
<td>-7.865***</td>
</tr>
<tr>
<td>QE</td>
<td>-6.485*</td>
<td>-13.765***</td>
</tr>
</tbody>
</table>

#### 4.2 Results of PCSE and GMM test

After the author got results from unit root tests, he applied various tests in regard of regular diagnosis check and based on the results of these tests, the author further applied two other tests to resolve the issues found by the
previous tests. These two tests include PCSE and GMM estimation tests. The detailed results of these tests have been presented in the table 4 of the study. The first aspect derived from these results is that internet access has significant impact on quality of education and 29.1% quality of education will be increased with one percent increase in internet access. This shows a direct relationship between the two variables. In addition, the impact of internet users has also been found as significant in context of quality of education and it will increase nu 28.3% with one percent increase in internet users. Next, mobile coverage also has significant impact on quality of education and this quality increases by 19.4% with one percent increase in mobile coverage. This is also a positive relationship of the two variables. Apart from these independent variables, the impact of two control variables i.e. population growth and literacy rate has been found as insignificant. These results can be concluded in such a way that only independent variables i.e. internet access, internet users and mobile coverage have significant impact on quality of education while the impact of control variables is insignificant (table 4).

Table 4. PCSE and GMM results

<table>
<thead>
<tr>
<th>Dependent Variable = QE</th>
<th>PCSE estimation</th>
<th>Sys-GMM estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>0.285***</td>
<td>0.291***</td>
</tr>
<tr>
<td></td>
<td>(0.637)</td>
<td>(0.737)</td>
</tr>
<tr>
<td>IU</td>
<td>0.276***</td>
<td>0.283**</td>
</tr>
<tr>
<td></td>
<td>(0.576)</td>
<td>(0.678)</td>
</tr>
<tr>
<td>MC</td>
<td>0.185*</td>
<td>0.194*</td>
</tr>
<tr>
<td></td>
<td>(0.864)</td>
<td>(0.843)</td>
</tr>
<tr>
<td>PG</td>
<td>0.078</td>
<td>0.083</td>
</tr>
<tr>
<td></td>
<td>(0.974)</td>
<td>(1.003)</td>
</tr>
<tr>
<td>LR</td>
<td>0.015</td>
<td>0.017</td>
</tr>
<tr>
<td></td>
<td>(1.035)</td>
<td>(1.238)</td>
</tr>
<tr>
<td>Constant</td>
<td>3.643**</td>
<td>3.682**</td>
</tr>
<tr>
<td></td>
<td>(1.857)</td>
<td>(0.994)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.742**</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.947)</td>
<td></td>
</tr>
</tbody>
</table>

| No. Of Observations     | 250            |                    |
| No. of Instruments      | -              | 248                |
| No. of Observations     | -              | 248                |
| Arellano-Bond test for AR (1) ($Pr W z$) | - | 0.063 |
| Arellano-Bond test for AR (2) ($Pr W z$) | - | 0.138 |
| Hansen test of overid restrictions | - | 0.847 |

5. Discussion and Conclusion

5.1 Discussion

The main motive behind this study was to check and study the impact of internet access, internet users and mobile coverage on quality of education in the presence of control variables, population growth and literacy rate. When the hypothesis developed in the literature review section of the study were analyzed and tested, all of them were accepted according to the results of the tests applied. In this regard, the impact of internet access has been found as significant in quality of education and this result is completely in accordance with a past study (Davinson & Sillence,
The impact of internet users has also been found as significant on education quality according to the results. Same result was shown in a study conducted in the past (Lenhart, Simon, & Graziano, 2001). The last hypothesis of significant impact of mobile coverage on education quality was also accepted and the same result was presented in a past study (Kim, Mims, & Holmes, 2006). Apart from these variables, two control variables were also included but the impact of these control variables i.e. population growth and literacy rate have not been found as significant. This result is also consistent with a past study (Gradstein & Kaganovich, 2004).

Conclusion
Internet access, internet users and mobile coverage are very important technological aspects and have many benefits. This study has been designed in order to study the impact of these aspects on quality of education in a country. For this purpose, the author has collected data from Asian countries for 30 years. This data has been collected from authentic resources. After collection, this data was tested and analyzed by applying various tests and approaches and the results of these tests and approaches have been given in the study in form of tables. These results indicate that the impact of internet users, internet access and mobile coverage have been found as significant in regard of quality of education. However, the impact of two control variables i.e. population and literacy rate have not been found as significant. In the last of the study, the author has mentioned some implications and benefits of this study in context of theory, practical and policy making. Moreover, some limitations of this study along with recommendations have also been discussed by the author.

5.2 Implications
The author has identified many theoretical, practical and policy making implications of this study. In this regard, this study will provide enough literature and knowledge about the aspects of internet access, internet usage and mobile coverage along with their impacts on quality of education. In addition, this study also provides assistance and guidance to the education related officials and technology related companies in order to introduce technology in several aspects of education so that the quality of education may be enhanced. The policy making officials and regulatory authorities may get assistance from this study in order to formulate such policies and regulations that when applied, will result in increase in quality of education in the country and also enhance the usage of technology in several aspects of education.

5.3 Limitations and Future Research Indications
The first point in the limitations of this study is that it covers only the countries included in Asian countries, but other countries and regions of the world may also be chosen for research purposes. The sample size of data was limited in this study and can be increased effectively in the future studies. A few specific tests have been sued by the author in this study. Some other tests may be applied that are related to panel studies. The last point is that the variables other than those used in this study must also be considered by the future researchers in their studies so that more and more literature can be generated on various topics.

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