

Acceleration of Digital Transformation of Education During COVID-19: A Comparative Study Between Developed and Developing Countries

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Abstract:

The COVID-19 epidemic has accelerated the digital transformation of society, causing changes in lifestyles in many nations. Digital technology has a significant potential to improve education since it empowers learning and provides learning chances that lead to access to more information. The first step in reducing inequality and transitioning to a digital economy is to improve everyone's access to technology, connection, and ICT infrastructure in education. The country's leading sector, businesses, and government are in charge of implementing the digitization process, which is now crucial to societal progress and daily living. However, education can boost workers' human capital and abilities, which raises labor productivity and contributes to the nation's economic growth. The problem of the study is that the educational institution had to deal with some issues like internet access availability and teachers' pressure to adjust to these changes rapidly. The

Hypothesis of the study stated that the digitalization has positive impact on the economic growth.

The study's primary goal is to examine how digital transformation might be used to address these issues. It also examines the tools and educational systems that support this process. Thus, the study will examine what aspects of the students' online lectures are effective as well as the challenges they encounter. (Alimov, R. 2007) described the shift to a digital economy is by as "a long process that will require significant investments and will correspond to current world trends." The study concluded that there is positive relation ship between digitalization and economic growth in both developed and developing countries.

Keywords: Digitalization, Digital Transformation, Economic Growth, Pandemic.

Introduction:

The Solow growth model, developed by Robert Solow, is an influential economic framework that analyzes the relationship between technology and economic growth. According to the model, technological advancements are seen as external factors that increase labor productivity and lead to higher output levels in the economy. This enables sustained economic growth and improved living standards. However, the Solow model does not explain the

determinants of technological change. In contrast, modern theories of endogenous growth, pioneered by economists like Paul Romer, emphasize the role of deliberate investments in research and development (R&D) and other factors in driving technological progress. These theories recognize that technological advancements can be influenced by human actions and investments, providing a more comprehensive understanding of the sources and determinants of economic growth. (Arendt, L.2015)

The neoclassical growth theory provides a framework for understanding the relationship between productivity, economic growth, and technological advancements brought about by ICT development. This theory emphasizes the role of factors like capital accumulation, technological progress, and human capital in driving long-term economic growth. ICT can have significant positive effects on GDP and economic growth, including the expansion of ICT capital, the demand for skilled labor, productivity gains, and technological advancements that spread across different sectors. These effects contribute to the overall development and prosperity of an economy. (Ganeva, R.2010)

The analysis conducted by (Aghaei & Rezagholizadeh, 2017) highlights the positive and significant impact of ICT investments on economic growth in OIC (Organization of Islamic Cooperation) countries for the period between 1990 and 2014. This finding suggests that the adoption and utilization of ICT can

play a crucial role in fostering economic development in these countries. The analysis provides evidence of the positive impact of ICT investments on economic growth in OIC countries, the specific context and circumstances of each country may vary. Therefore, when formulating policies to encourage ICT investment, governments should consider their unique socioeconomic conditions, infrastructure requirements, and the needs of their populations.

(Majid, A. & Mahdieh, R. 2017) provided a study that underscores the importance of ICT investment as a driver of economic growth and suggests that policymakers should strive to create an enabling environment that fosters ICT development and utilization in order to harness its potential benefits.

(Pradhan, R. et al. 2018) explored the correlations between many variables such as real GDP per capita, consumer price index ,ICT infrastructure, , labor force participation rate, and gross fixed capital formation during the period 20001 to 2012 in the G-20 countries. The study employed a cointegration model to examine the long-term relationship between these variables. The conclusion that ICT increases GDP per capita aligns with the idea that ICT investments and improvements in infrastructure can enhance productivity, efficiency, and innovation, thereby positively impacting economic growth. The study's findings suggest that the development

and adoption of ICT can have a significant and positive effect on the economic performance of G-20 countries.

(Niebel,T.2014) focused on investigating the effects of (ICT) on economic growth across developing, emerging, and developed nations. The analysis utilized panel data regressions to examine the relationship between ICT capital and GDP growth over the period from 1995 to 2010. One of the main findings of the study was a positive correlation between ICT capital and GDP growth. This suggests that investments in ICT have the potential to contribute to economic growth across all types of economies, regardless of their development status.

(Bahrini, R.& Qaffas, A. 2019) examined the effects of ICT diffusion on the economic development of 45 developing nations in the MENA (Middle East and North Africa) and SSA (Sub-Saharan Africa) regions. The analysis employed panel data and the Generalized Method of Moment (GMM) growth approach to investigate the relationship between ICT variables and economic growth over the period from 2007 to 2016. The study's conclusion suggests that information and communication technology, including broadband, mobile phones, and Internet usage, play a significant role in driving economic growth in the examined developing nations. This finding highlights the importance of ICT diffusion in promoting economic development in the MENA and SSA regions.

(Shidiev, T. et.al. 2021) focus on analyzing the causality between economic growth and ICT development in the emerging economies of Central Asian countries. The analysis utilizes panel data from 2000 to 2018 to investigate the relationship between ICT variables and GDP per capita in these nations. The study's findings suggest that ICT has a beneficial impact on GDP per capita in the Central Asian countries under examination. This implies that the development and adoption of ICT contribute positively to economic growth and development in these nations. Furthermore, the study indicates that ICT plays a crucial role in influencing various economic variables, including trade openness, inflation, unemployment, and consumption spending.

The endogenous models developed by Romer suggest that the stock of human capital is the growth engine, in contrast to the neoclassical models provided by Lucas which suggested that growth was primarily driven by the accumulation of human capital. Numerous empirical studies, which rely on the advancement of technology to fuel economic expansion, attest to the favorable correlation between education and growth in the economy. The degree of education accessible within the economy determines how far the nation advances because it equips people with the knowledge and abilities needed to comprehend and manage the challenges of economic expansion, it raises the standard of living for people, which promotes

national development. Productivity can be improved and increased by investing in education. (Arendt, L.2015)

(Dookhan, K., & Fauzel, S. 2010) conducted a study on the effects of education investments made in Mauritius between 1990 and 2006; the study's analysis came to the conclusion that human capital increased the country's output and made it easier to adopt new technologies.

(Wai, S. 2017), examined the impact of education levels particularly primary, secondary, and tertiary on economic growth in Malaysia from 1984 to 2012. The study found a strong correlation between economic growth and educational attainment. Particularly, postsecondary and primary education have been found to have a favorable correlation with economic growth, whereas secondary education has a negative correlation.

(Kotásková, et al. 2018) employed econometric estimations with the Granger Causality Method and the Co integration Method to examine the connection between economic growth and education in India between 1975 and 2016. The study came to the conclusion that education is crucial to India's economic development.

The COVID-19 epidemic, which began to spread in December 2019 and drove several countries to lock down and close schools, compelled the digital revolution of education. As a

result, Internet connectivity is now a critical need. Additionally, a lot of countries throughout the world are moving to online education. As a result, education is accessible everywhere, even our homes, thanks to digital learning resources and materials.

In response to this crisis, several nations are implementing emergency measures like health guidelines, behavior modification for individuals and institutions, consideration for low-income families, government collaboration with all private sector partners, and the development of self-learning skills. In order to develop education systems, take advantage of online learning and digital technology, close the achievement gap between students and work toward educational equity, and improve teaching and learning processes through the use of various tools, the government must make investments in innovative research support. (Schilirò, D. (2021).

We discovered that millions of pupils in China will benefit from the government's successful development of a national educational platform. ICT businesses have improved the Internet and provided free digital technology courses for educators and students. The incorporation of digital technology into all facets of education, providing value to students and radically altering their operational framework, is known as the "digital transformation of education."(OECD,2016)

Any government that wants to implement online learning must overcome certain obstacles, like in remote nations, network coverage may not be adequate for all students and teachers using the online platform at once due to inadequate infrastructure, thus resulting in educational inequality. Not every country has access to the internet, computers, laptops, broadband, and phones that are necessary for online learning. Online learning can have a detrimental impact on the quality of education since teachers are often unable to accept it because they lack the necessary experience. Because of noise and disruptions that cause students to become distracted, the learning environment in which they are situated may not be ideal for learning. (OECD,2021)

Research conducted in China on more than 10,000 teachers found that 92.0% of them reported experiencing tension and anxiety as a result of online learning. Poor online teaching infrastructure and a lack of technology assistance are the reasons behind their study's recommendation that teachers receive online education methods training. (Yuebo, L. et al. 2022)

Don Tapscott was the one who initially presented the idea of the "Digital Economy." It was determined in the 1990s that the development of the Internet and the expansion of the economy are directly related. But between the years 2000 and 2010, the relationship evolved and changed, becoming one of economic growth and the use of information and communication technologies

(ICTs). The digital infrastructure, the social adoption of digital technologies, and investments in ICTs are among the measures of digital economic growth released by the Organization for Economic Co-operation and Development (OECD) in 2014. ICT is seen as a key component of the digitalization process, which will generate and expand chances for economic growth, with different consequences for industrialized and developing nations. (Abubakarov, R. et al. 2020)

To achieve the desired level of digitalization, educational institutions must first embrace technological advancement. To do this, they must update their strategies to become intelligent organizations by reorienting their operations toward digitalization. Additionally, they must support the integration of digital-based processes into all systems and offer digital platforms for teaching and learning.

The primary forces behind the desired digital transformation:

- Enhance competitiveness: to do this, the school must enroll fewer students and make up for it with more effective institutional operations.
- Cost control: The spiral administrative method of cost control is an alternate approach that minimizes staff time expenditures while also lowering the quantity of materials required for file storage. The advent of software as a service (SaaS) solution has made it much easier for management of

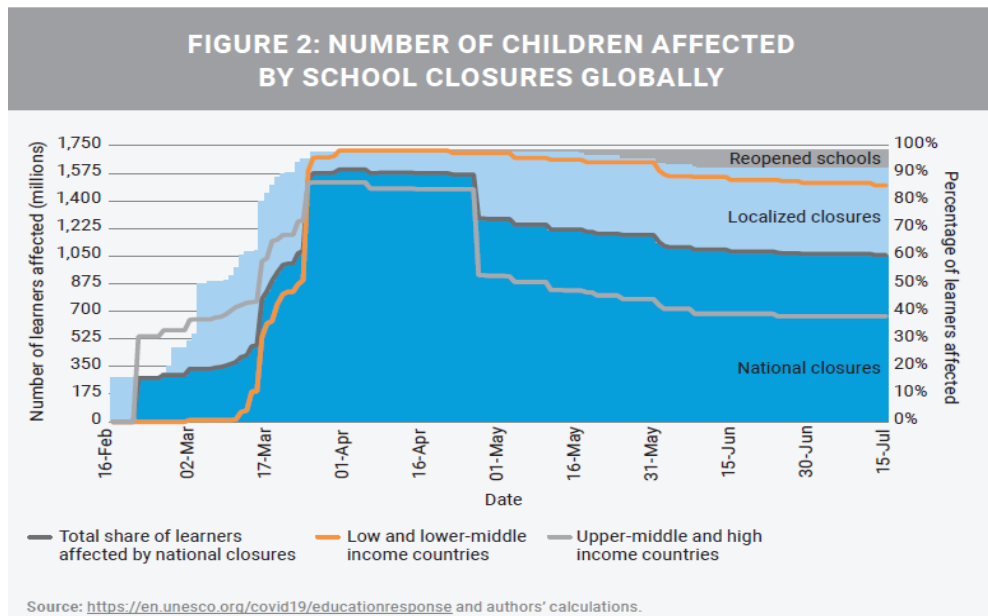
higher education institutions (HEIs) to get and deploy these solutions without having to spend time and resources working with IT departments or specialized teams.

- Better user experience: Students can get any relevant information from any smart device at any time when they utilize their smartphones.
- Enhanced agility: Digital transformation is a multifaceted process that goes beyond software. To adjust to the market, it involves determining the needs and interests of institutions during the decision-making process. Using technology to meet the demanding needs of staff, professors, and students is a quick and adaptable solution. Elite HEIs are always looking for innovative methods to enhance their operations, particularly those that change the path that students take while pursuing their education. In this setting, creative technology utilization creates ongoing improvements to the user experience to maintain students, staff, and professors happy and productive. By implementing these four drives, the educational system will become digitalized with beneficial results. (Abubakarov, R. et al. 2020)

After the pandemic, there has been a strong movement toward a worldwide educational environment, and this has made digitization in education imperative. Thus, transforming educational materials into a digital format that a computer can play is known as

digitalization in education. It was mentioned that one of the people who contributed to the World Wide Web's transformation was Tim Berners-Lee. In 2015, the United Kingdom became the first country to implement ICT into its school curriculum. Additionally, the European Union created a policy in 2014 called Digital Agenda for Europe, which focuses on ICT use in the educational sector.(World economic reform,2020)

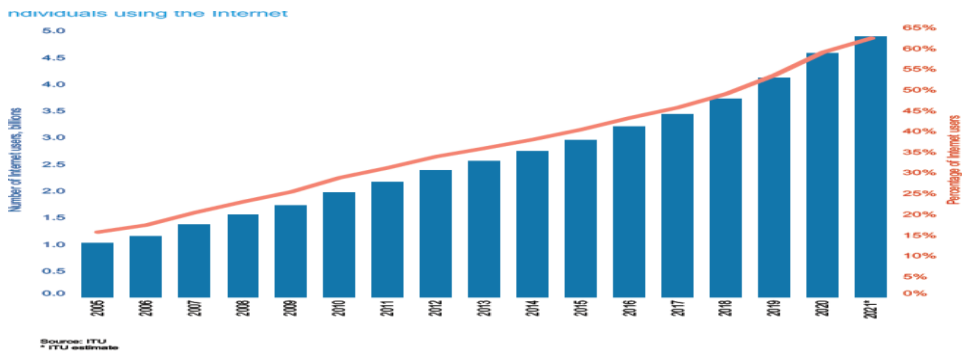
In industrialized nations, ICT is now a necessary component of education. Digital technology has empowered and enabled innovative learning environments in classrooms. Nevertheless, the adoption of digitalization in education has presented several obstacles for poor nations, including issues with digital fairness outside of schools, scarce and challenging digital access, challenging connectivity, and a lack of resources. (Schilirò, D. 2021).



Source: United Nations, 2020, Education during covid-19

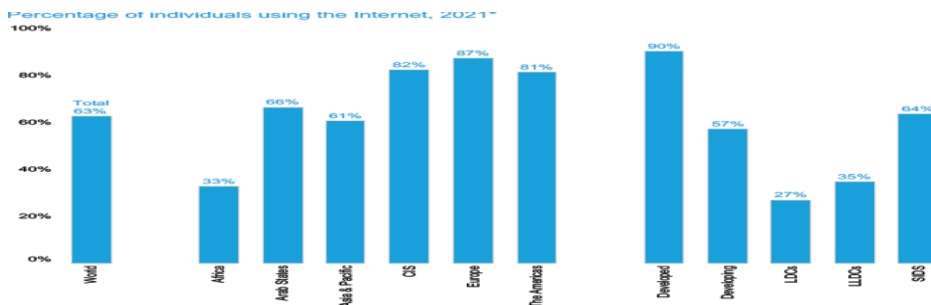
The accompanying graph indicates that COVID-19 had an impact on schools throughout the world and kept a large number of students out of school. It was discovered that 1500 students per million in high- and upper-middle-income nations are impacted by closing schools. However, the impact is greater in the low- and lower-middle-income countries, where 1750 students per million are impacted by closing schools. The International Telecommunication Union (ITU), a specialized agency of the United Nations dealing with information and communication technologies (ICTs), reports robust global growth in Internet usage,

with an estimated 4.9 billion people using the Internet in 2021 compared to an estimated 4.1 billion in 2019.



Source: ITU, 2021

The number of internet users climbed from 4.1 billion in 2019 to 4.9 billion in 2021 during COVID-19; however, as we said, 2.9 billion people who live in poor nations did not utilize the internet because of various barriers.



Source: ITC, 2021

The percentage of people using the internet rose from 51% in 2019 to 63% in 2021, according to the graph above. Nevertheless, developed countries had an increase in internet usage from 87% in 2019 to 90% in 2021, while developing countries saw an increase from 44% in 2020 to 57% in 2021.

Methodology:

Based on the literature review above, the study employs two econometric models—one for developed countries and the other for developing countries—and cross-sectional data to empirically analyze the effects of digitization on economic growth during COVID-19 in 2020. The information is available through the World Bank's World Development Indicators.

Developed Countries Model:

The data included in the research is from 41 developed nations in 2020. The GDP is the dependent variable, while the school enrollment for a given territory, the fixed broad band that represents digitalization, consumption, and inflation are the independent factors. The variables are processed using logarithms, and the results can be shown as follows.

$$GDP = a + b \text{ fixed broad} + b \text{ sch enr} + \text{consum} + \text{infl} + ER$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.05387	1.273462	10.25070	0.0000
LOG(SCHOOL_ENR_X4)	-0.574811	0.261185	-2.200776	0.0343
LOG(FIXED_BROAD_X1)	0.849083	0.060652	13.99915	0.0000
INFLATIONCPI_X2	-0.125216	0.064096	-1.953569	0.0586
LOG(CONSUMPTION_X7)	0.125836	0.040041	3.142689	0.0033
R-squared	0.893337	Mean dependent var	26.25294	
Adjusted R-squared	0.881485	S.D. dependent var	1.680202	
S.E. of regression	0.578426	Akaike info criterion	1.856837	
Sum squared resid	12.04476	Schwarz criterion	2.065810	
Log likelihood	-33.06517	Hannan-Quinn criter.	1.932934	
F-statistic	75.37765	Durbin-Watson stat	1.865642	
Prob(F-statistic)	0.000000			

Source: Calculated by the researcher using E-Views Software

From the above table, the adjusted R² showed a value of 88%, which reflects that the model is well fitted and the used variables are explaining the variation in GDP. DW is recording a value of 1.86, which records no autocorrelation in the sample used, reflecting a well-designed model. The main independent variable, fixed broad line that is reflecting digitalization affects the dependent variable (GDP), with a coefficient value of 84%, this means that 84% of the changes that are taking place in GDP are affected by digitalization explained by fixed broad line. This also align with the stated hypothesis, that is mentioning a positive impact of

digitalization on GDP reflecting economic growth in developed countries. On the other hand, the territory's school enrollment has a negative and significant impact on economic growth. however this agree with the study of Sedat Gumus,S. and Kayhan,S. which states that The lack of a causal relationship between economic development and enrollment in higher education, as well as the absence of a direct association between changes in GDP per capita and higher education enrollment in Turkey, suggests that acquiring higher-education degrees may not immediately lead to higher productivity and economic growth. This implies that the establishment of new universities and programs may not necessarily result in the production of high-quality graduates who can effectively contribute to economic growth. The relationship between higher education and economic outcomes is complex and influenced by various factors beyond enrollment, such as labor market conditions, infrastructure, and government policies. Therefore, while higher education is generally important for long-term economic development, its immediate impact on productivity and economic growth may be limited.

Developing Countries Model:

The data from 29 developing nations in 2020 is chosen for the paper. The GDP is the dependent variable; government spending on education, internet servers that symbolize digitalization, consumption, inflation, population, and

unemployment are the independent variables. The variables are logarithmically processed and can be shown as follows:

$$GDP = a + b \text{ secure server} + b \text{ gov exp} + \text{consum} + \text{infl} + \text{pop} + \text{unemp} + ER$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	78.25860	12.35917	6.332029	0.0000
LOG(SECURE)	0.886544	0.184826	4.796647	0.0001
LOG(GOV_EXPENDITURE)	0.678249	0.996068	0.680926	0.5030
INFLATION_CPI	-0.034444	0.053126	-0.648351	0.5235
LOG(CONSUMPTION)	-13.11643	2.677577	-4.898618	0.0001
POPU	1.444120	0.546096	2.644443	0.0148
LOG(UNEMPLO)	-1.496303	0.565819	-2.644492	0.0148
R-squared	0.778328	Mean dependent var	29.27554	
Adjusted R-squared	0.717872	S.D. dependent var	3.561951	
S.E. of regression	1.891955	Akaike info criterion	4.319604	
Sum squared resid	78.74890	Schwarz criterion	4.649641	
Log likelihood	-55.63426	Hannan-Quinn criter.	4.422968	
F-statistic	12.87430	Durbin-Watson stat	2.359704	
Prob(F-statistic)	0.000003			

Source : Calculated by the researcher using E-Views Software

From the above table, the adjusted R² showed a value of 72%, which reflects that the model is well fitted and the used

variables are explaining the variation in GDP. DW is recording a value of 2.35, which records no autocorrelation in the sample used, reflecting a well-designed model. The main independent variable, secure internet connection that is reflecting digitalization affects the dependent variable (GDP), with a coefficient value of 88%, this means that 88% of the changes that are taking place in GDP are affected by digitalization explained by secure internet connection. This also align with the stated hypothesis, that is mentioning a positive impact of digitalization on GDP reflecting economic growth in developing countries that linked with the study by Habibi and Zabardast (2020) focused on analyzing the impact of ICT (Information and Communication Technology) and education on economic growth in the Middle East countries and those included in the OECD. The key findings of the study suggest that ICT technology has a positive influence on economic growth, irrespective of a country's level of development. Additionally, the authors highlight that the emergence of more advanced technologies, particularly broadband technologies, has further contributed to economic growth.

Conclusion:

- The COVID-19 pandemic accelerated the digital transformation of educational institutions worldwide, as schools and universities were compelled to shift to virtual learning. This shift towards digitalization had a positive

impact on economic growth in both developed and developing countries. However, in developed countries, there was a negative association between school enrollment, as indicated by the territory percentage, and economic growth. These findings emphasize the importance of embracing digital technologies in education, while also highlighting the need for further exploration and understanding of the complex relationship between education, enrollment rates, and economic growth in different contexts. The study recommended

- enhancing the infrastructure of connectivity and internet access, as this will ensure equality among learners across different countries, no matter the degree of development of these countries.
- Empowering capacity building, through providing training opportunities for staff and students.
- Encouraging partnerships with private sector and worldwide institutions such as UNESCO, ILO and WB.
- Increasing government spending on education and ICT.

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